COMMONWEALTH INST.
MYCOLOGY LIBRARY

Vol. XXXVIII NOVEMBER-DECEMBER, 1954 Nos. 6-7

THE PHILIPPINE AGRICULTURIST

UNIVERSITY OF THE PHILIPPINES PUBLICATIONS SERIES A

CONTENTS

Test of Five Insecticides in the Control of Insects Affecting Corn ..... *Avelino F. Banaag and G. B. Viado* 419

A Comparison of the Efficiency of Randomized Blocking and of Complete Randomization in Pot Tests .... *Rodolfo N. Pascual* 435

The Presence of Trichomes on Ten Varieties of Kenaf ..... *Miguel C. Sison* 444

Feeding Aurofac to 12-Week-Old Pullets Range-Reared to 24 Weeks of Age ..... *Francisco C. Salinas* 465

The Rural Credit System in Naghalin, Kanangga, Leyte ..... *Mario V. Manulat* 471

The Use of Machinery in the Production of Sugar Cane ..... *Romeo A. Obordo* 484

The Digestibility of Tropical Kudzu (Pueraria Javanica) and Poñgapong (Amorphophalus Campanulatus) by Swine ..... *J. K. Loosli, Valenie Villegas, and L. A. Ynalvez* 491

Effects of Varying Amounts of Ammonium Phosphate Fertilizer on Kenaf ..... *Raul R. Solidum* 494

Increment in Body Temperature and Respiration of Philippine Steers After Plowing ..... *Valente Villegas and Crispulo Q. Quibin* 499

Fertilizer Tests on Corn ..... *Valeriano C. Calma and Pedro B. Escuro* 503

Methods of Processing Vanilla Pods .. *Pilar C. Tolibas* 508

Biochemical Studies on Abacá Mosaic Virus and Bunchy-Top of Abacá Virus: I. Effect of Virus Infection on Catalase Activity of the Host .. *Apolinario R. Carañgal, Jr., and Elvira B. Manzanilla* 515

College and Alumni Notes 518

Published by
THE COLLEGE OF AGRICULTURE
AND CENTRAL EXPERIMENT STATION
UNIVERSITY OF THE PHILIPPINES

The Philippine Agriculturist

(University of the Philippines Publications Series A)

Editor

L. B. UICHANCO, SC.D. ..... *Dean, College of Agriculture*

Managing Editor

G. O. OCFEMIA, PH.D. ..... *Professor of Plant Pathology*

Copy Editor

NORA J. CRUZ, A.B. ..... *Instructor in English*

Business Manager

JOSÉ M. CAPINPIN, PH.D. ..... *Associate Professor of Agricultural Botany*

Advisory Board

F. O. SANTOS, PH.D. ..... *Head, Department of Agricultural Chemistry*
VALENTE VILLEGAS, PH.D. ..... *Head, Department of Animal Husbandry*
FRANCISCO M. SACAY, PH.D. ..... *Head, Department of Agricultural Education*
LEON G. GONZALEZ, PH.D. ..... *Head, Department of Agronomy*
A. B. CATAMBAY, M.S. ..... *Head, Department of Agricultural Engineering*
SILVERIO M. CENDAÑA, PH.D. ..... *Assistant Head, Department of Entomology*
NICOLAS L. GALVEZ, PH.D. ..... *Acting Head, Department of Soils*

Authors of articles appearing in THE PHILIPPINE AGRICULTURIST are severally responsible for the opinions expressed therein.

THE PHILIPPINE AGRICULTURIST is published monthly, except in April and May, beginning with Volume 35, by the College of Agriculture and Central Experiment Station, University of the Philippines, Los Baños, Laguna. The subscription price is ₱6.00 a year in the Philippines and $4.00 (U.S. currency) elsewhere; the price of single copies, ₱0.75 in the Philippines and $0.50 (U.S. currency) elsewhere.

Business correspondence should be addressed to the Business Manager, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines. All remittances should be made payable to THE PHILIPPINE AGRICULTURIST.

Communications for the editor should be addressed to the Editor, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines.

Publications sent in exchange for THE PHILIPPINE AGRICULTURIST should be addressed: Library, College of Agriculture and Central Experiment Station, College, Laguna, Philippines.

Entered at the Post Office at College, Laguna, Philippines, as second-class mail matter.

TESTS OF FIVE INSECTICIDES IN THE CONTROL OF INSECTS AFFECTING CORN [1]

AVELINO F. BANAAG AND G. B. VIADO

Of DDT, methoxychlor, BHC, dieldrin, and lead arsenate, only dieldrin showed a burning effect on the ears, stalks, leaves, and tassels of the corn plants. In all the sprayed lots the DDT lot gave the highest percentage of undamaged ears. The highest percentage of undamaged stalks was given by the dieldrin lot among the lots sprayed three times and by the DDT lot among the lots sprayed six times. The highest percentage of plants with undamaged leaves was shown by the DDT lot among the lots sprayed three times and by the dieldrin lot among those sprayed six times. No advantage was gained by spraying the plants six times instead of three. Against the larvae of the corn earworm, the corn stalk borer, and the nymphalid butterfly, DDT was the most effective in the laboratory, followed by drieldrin. Against *Plusia chalcytes* dieldrin was the best, closely followed by DDT.

In some parts of the Philippines, as much as fifty per cent or more of the corn crop is lost to insects. The use of insecticides is a common practice of corn farmers in other countries, but in the Philippines this control measure is practically unknown. The present study was therefore conducted from December, 1952, to January, 1954, in the experimental field of the Department of Agronomy and in the laboratory of the Department of Entomology to determine under Philippine conditions the efficacy of five insecticides in the control of insects affecting corn and the effects of the insecticides on the corn plants, as well as to secure data on which to base spraying schedules for the control of corn insects.

MATERIALS AND METHODS

Insecticidal sprays. Five proprietary insecticidal concentrates were tested: (1) 50 per cent methoxychlor dust, (2) 50 per cent BHC dust containing 10 per cent gamma isomer, (3) 50 per cent DDT dust, (4) 96 per cent lead arsenate dust, and (5) dieldrin emulsified concentrate containing approximately fifteen per cent active ingredient.[2]

Tap water was used to make the suspensions of the insecticides and to dilute the liquid concentrate. Methoxychlor, BHC, DDT, and lead arsenate were used in proportions of 2.6 grams to a liter of water; dieldrin, at the rate of 1.6 cc. to a liter of water. The insecticides were sprayed with compressed-air hand sprayers, each with

[1] Central Experiment Station Contribution No. 1791. Thesis presented by the senior author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Entomology under the direction of the junior author, who also supplied additional data on the laboratory test.

[2] Dieldrex 15, a Shell Co. product.

[THE PHILIPPINE AGRICULTURIST, Vol. 38, Nos. 4-5, September-October, appeared in March, 1955.]
THE PHILIPPINE AGRICULTURIST, VOL. 38, NOS. 6-7, NOVEMBER-DECEMBER, 1954

a 2-gallon capacity, at a pressure maintained between 25 and 45 pounds to a square inch.

Field tests. A 1320-square-meter piece of land which had been planted to corn for three successive years was prepared for planting with a tractor. With a corn planter attached to the tractor, seeds of the Cuban red variety of corn were planted at the rate of two to three seeds to a hill. The distances of planting were 60 centimeters between hills and 80 centimeters between furrows. Ammonium phosphate fertilizer at the rate of 150 kilograms to a hectare was applied immediately after planting.

The field was divided into six randomized blocks of 11 rows each. Ten rows were treated and one served as control. Blocks I, II, and III were sprayed three times at 10-day intervals; blocks IV, V, and VI, six times at five-day intervals. Each block contained two replications of each treatment.

The first spraying was done when the first insect infestation was noted. At that time the corn plants were 45 days old, and the silks and tassels had not yet appeared. The sprays were applied as evenly as possible to all parts of the plant. Care was taken to avoid the contamination of the near-by rows and the breaking of stalks and other parts of the corn plants. After each spraying, the effects of the different insecticides on the ears, stalks, leaves, and tassels were observed.

The corn ears were harvested at the age of 120 days. The following observations were carefully noted: (1) total number of plants to the row, (2) total number of ears to the row, (3) total number of undamaged ears in each treatment, (4) total number of undamaged stalks, and (5) total number of plants with undamaged leaves.

Laboratory tests. The effects of the sprays on the corn earworm, *Heliothis armigera,* were studied in the laboratory. With a hand atomizer, one young unhusked ear of corn was sprayed thoroughly with an insecticide and then placed side by side with an untreated ear in a test cage. Larvae of the corn earworm of about the same size were placed on top of the treated ear. The number of larvae that died and the extent of feeding were noted after every 22 hours until all the larvae in the treated cages were dead. The repellent action of the insecticide on the larvae was also observed. Two tests were conducted with each species of insect.

In the tests on the corn stalk borer, *Pyrausta salintialis,* a half-foot of fresh stalk of young corn about to tassel was sprayed evenly with an insecticide and then placed side by side with an unsprayed stalk in a test cage. Larvae of the same size were placed on the treated stalk. Observations on the number of larvae that died, the repellent action of the insecticide, and the extent of feeding were made every 22 hours until all the larvae in the treated cages were dead.

The other insects used in the laboratory tests were the larvae of a nymphalid butterfly, *Cyllo leda,* and the larvae of *Plusia chal-*

cytes. The corn leaves for the laboratory tests were prepared in the same way.

DISCUSSION OF RESULTS

Insects that affected the plants. The insects that attacked the corn plants in the field during the experiment were (1) *Heliothis armigera,* (2) *Pyrausta salintialis,* (3) *Monolepta bifasciata,* (4) *Cyllo leda,* and (5) *Plusia chalcytes.* There were not enough available specimens of the corn-silk beetle, *Monolepta bifasciata,* for laboratory tests.

Phytocidal effect of the insecticidal sprays. In the field tests, only dieldrin showed a burning effect on the leaves, tassels, and ears of the corn after 24 hours. The affected parts of the plants were able to recover after four days. BHC, DDT, methoxychlor, and lead arsenate did not affect any part of the treated plants.

Damage on the ears. The results of the field tests on the corn earworm, based on the yield of undamaged ears, are shown in tables 1a and 1b. In the three-spraying test, the rows sprayed with DDT gave the highest mean percentage of undamaged ears. The increases in yield of undamaged ears over the control were 25.5 per cent for DDT, 18.9 per cent for dieldrin, 14.3 per cent for BHC, 12.2 per cent for lead arsenate, and 6.5 per cent for methoxychlor. All the treatments, except that with methoxychlor, were significantly better than the control.

In the blocks that were sprayed six times, the insecticides effected the following increases in percentage of undamaged ears over the control: DDT, 46.5; dieldrin, 32.2; BHC, 17.9; lead arsenate, 17.8; and methoxychlor, 9.9. The difference in yield of undamaged ears between the DDT treatment in the three-spraying test and that in the six-spraying test was significantly high, showing the higher degree of effectiveness of six applications of the insecticide.

Kulash (1950) found that corn ears treated with DDT in the proportion of 1 gram of the insecticide to 100 ml. of water gave the greatest percentage of undamaged ears. The superiority of DDT to other insecticides in the control of the earworm was also reported by Ewing, Parencia, and Ivy (1947), Kelsheimer (1947), Common (1948), Bacon (1950), Ditman (1950), Anderson *et al.* (1951a and b), Rutschky (1951), Eden (1952), and Wene, Blanchard, and Walter (1952).

Damage on the stalks. The results of the field tests on the European corn borer, based on the percentage of undamaged stalks, are summarized in tables 2a and 2b. In the lots sprayed three times, dieldrin was the best insecticide against the European corn borer. It reduced the infestation by 32.6 per cent. BHC reduced the infestation by 29.3 per cent; DDT, 29.1 per cent; methoxychlor, 23.4 per cent; and lead arsenate, 21.4 per cent.

In the lots sprayed six times, the DDT lot gave the highest percentage of undamaged stalks, 32.0 per cent over the control. The

other insecticides reduced the infestation as follows: dieldrin, by 28.1 per cent; BHC, 21.1 per cent; lead arsenate, 16.7 per cent; and methoxychlor, 14.8 per cent. No advantage was gained by increasing the number of sprayings from three to six.

Langford, Cory, and Foster (1950) and Hawkins (1951) reported that DDT was effective in controlling the borer. Cutkomp and Holdaway (1950), however, found dieldrin more effective than DDT against the insect.

Damage on the leaves. Based on the mean percentage of plants with undamaged leaves, DDT gave the best control against *Cyllo leda* and *Plusia chalcytes* in the lots sprayed three times (tables 3a and 3b). A comparison of the mean percentages of the treated and the untreated plants shows that DDT reduced the infestation over the control by 27.7 per cent. Dieldrin reduced infestation by 22.2 per cent; lead arsenate, 13.3 per cent; methoxychlor, 13.2 per cent; and BHC, 12.6 per cent.

In the lots sprayed six times, dieldrin was the most effective, the difference over the control being 23.2 per cent. DDT, with a difference over the control of 19.3 per cent, was the next best, followed by lead arsenate with 18.8 per cent, methoxychlor with 16.3 per cent, and BHC with 6.0 per cent. No advantage was gained by spraying the plants six times instead of three.

Effects on the larvae of corn earworm. On the basis of 15 larvae of the corn earworm in each treatment in the first test and 10 in the second, DDT had the shortest killing time and methoxychlor the longest (table 4). The larvae crawled on the ears treated with DDT and dieldrin but did not attempt to feed. Identical results were obtained by Viado and Estioko (1951) on this insect feeding on tomato fruits. The larvae in the other treatments fed on both the treated and the untreated ears. Not a single larva in the control died during the tests.

Effects on the larvae of cornstalk borer. DDT and dieldrin killed all the larvae of the cornstalk borer in 44 hours in the first test, but in the second test dieldrin killed them in 66 hours (table 5). DDT had a faster killing effect than dieldrin. Lead arsenate was the least effective. None of the larvae in the control died during the tests.

Effects on the larvae of Plusia chalcytes. In the first test dieldrin and DDT both gave complete kill after 44 hours, but in the second test DDT killed all the larvae in 66 hours (table 6). Dieldrin had a faster killing effect, indicating that the larvae were more susceptible to it. Methoxychlor and lead arsenate were the least effective. All the larvae fed equally on the treated and the untreated leaves. Not a single insect died in the control.

Effects on the larvae of nymphalid butterfly. DDT was found to be the most effective against the larvae of the nymphalid butterfly (table 7). BHC, methoxychlor, and lead arsenate had the longest

killing time. All the larvae in the different treatments fed equally on the treated and untreated leaves. Not one died in the control during the tests.

LITERATURE CITED

ANDERSON, L. D., O. G. BACON, H. T. REYNOLDS, AND J. E. SWIFT. 1951a. Investigations of corn earworm control on sweet corn in California in 1950. Jour. Econ. Entom. 44: 966–971.

ANDERSON, L. D., H. T. REYNOLDS, J. W. HASHE, AND J. E. SWIFT. 1951b. Studies on control of corn earworm on sweet corn in Southern California in 1949. Jour. Econ. Entom. 44: 905–909.

BACON, OSCAR G. 1950. Control of corn earworm on sweet corn in Northern California. Jour. Econ. Entom. 43: 364–371.

COMMON, I. F. B. 1948. Control of corn earworm on tomatoes. Queensland Agric. Jour. 66: 1–22.

CUTKOMP, L. K., AND F. C. HOLDAWAY. 1950. Small scale field evaluation of insecticides for corn borer control. Jour. Econ. Entom. 43: 433–438.

DITMAN, L. P. 1950. Control of corn earworm and other pests of corn. Jour. Econ. Entom. 43: 191–193.

EDEN, W. G. 1952. Control of corn earworm in sweet corn in Alabama. Jour. Econ. Entom. 45: 105–108.

EWING, K. P., C. R. PARENCIA, JR., AND E. E. IVY. 1947. Cotton insect control with Benzene hexachloride alone or in mixture with DDT. Jour. Econ. Entom. 40: 374–381.

HAWKINS, JOHN. 1951. Importance of time of application of DDT sprays in control of European corn borer. Jour. Econ. Entom. 44: 569–571.

KELSHEIMER, E. G. 1947. The use of some organic insecticides in the control of earworms attacking sweet corn. Florida State Hort. Soc. Proc. 1946: 121–123.

KULASH, WALTER M. 1950. Further tests for earworm control in sweet corn. Jour. Econ. Entom. 43: 430–432.

LANGFORD, GEORGE S., ERNEST N. CORY, AND J. R. FOSTER. 1950. Clearance ground machinery developed in Maryland for spraying corn. Jour. Econ. Entom. 43: 198–202.

RUTSCHKY, C. W. 1951. Corn earworm control experiments in Pennsylvania in 1950. Jour. Econ. Entom. 44: 567–569.

VIADO, G. B., AND ROMAN R. ESTIOKO, JR. 1951. Tests of five insecticidal dusts in the control of insects affecting tomatoes and eggplants. Philippine Agriculturist 35: 343–357.

WENE, GEORGE P., R. A. BLANCHARD, AND E. V. WALTER. 1952. Relation of corn earworm resistance in sweet corn to efficiency of insecticide sprays. Jour. Econ. Entom. 45: 931–933.

TABLE 1a

Efficacy of five insecticidal sprays based on the number of undamaged ears

TREATMENT	BLOCK	ROW NUMBER	THREE SPRAYINGS				SIX SPRAYINGS			
			Number of plants to the row	Number of ears to the row	Number of undamaged ears	Percentage of undamaged ears	Number of plants to the row	Number of ears to the row	Number of undamaged ears	Percentage of undamaged ears
BHC	I	1	63	54	2	3.7	57	52	14	26.9
		2	63	60	13	21.7	57	54	11	20.4
	II	1	60	58	13	22.4	62	90	14	15.6
		2	65	60	9	15.0	90	65	13	20.0
	III	1	57	50	12	24.0	53	53	13	24.5
		2	73	47	15	31.9	77	74	20	27.0
Dieldrin	I	1	61	61	17	27.9	71	67	20	29.9
		2	62	73	28	38.4	69	65	22	33.8
	II	1	69	56	10	17.9	88	79	23	29.1
		2	57	61	12	19.7	94	96	35	36.5
	III	1	50	55	14	25.5	78	60	24	40.0
		2	50	46	6	13.0	64	74	38	51.4
DDT	I	1	61	69	18	26.1	73	72	31	43.1
		2	62	75	18	24.0	65	66	28	42.4
	II	1	63	66	19	28.8	56	58	33	56.9
		2	66	63	13	20.6	85	86	38	44.2
	III	1	70	57	21	36.8	78	74	50	67.6
		2	56	65	29	44.6	73	61	31	50.8

TABLE 1a (continued)

TREATMENT	BLOCK	ROW NUMBER	THREE SPRAYINGS				SIX SPRAYINGS			
			Number of plants to the row	Number of ears to the row	Number of undamaged ears	Percentage of undamaged ears	Number of plants to the row	Number of ears to the row	Number of undamaged ears	Percentage of undamaged ears
Methoxychlor	I	1	57	68	2	2.9	58	75	7	9.3
		2	60	50	2	4.0	72	59	3	5.1
	II	1	72	70	8	11.4	79	92	19	20.7
		2	57	57	10	17.5	68	82	16	19.5
	III	1	50	52	8	15.4	73	65	14	21.5
		2	60	59	12	20.3	66	58	8	13.8
Lead arsenate	I	1	59	52	15	28.8	66	61	3	4.9
		2	68	65	14	21.5	64	63	19	30.2
	II	1	53	38	2	5.3	98	96	23	24.0
		2	58	53	4	7.5	70	73	23	31.5
	III	1	47	53	10	18.9	63	54	8	14.8
		2	45	34	8	23.5	55	51	18	35.3
Control	I	1	78	69	7	10.1				
		2	81	84	3	3.6				
	II	1	62	74	1	1.4				
		2	52	58	3	5.2				
	III	1	53	60	5	8.3				
		2	67	61	5	8.2				

TABLE 1b

Efficacy of five insecticidal sprays based on the transformed angles of percentages of undamaged ears

BLOCK	THREE SPRAYINGS					SIX SPRAYINGS					CONTROL	TOTAL
	BHC	Dieldrin	DDT	Methoxy-chlor	Lead arsenate	BHC	Dieldrin	DDT	Methoxy-chlor	Lead arsenate		
I	11.09	31.88	30.72	9.81	32.46	31.24	33.15	41.03	17.76	12.79	18.53	
	27.76	38.29	29.33	11.54	27.63	26.85	35.55	40.63	13.05	33.34	10.94	
Total	38.85	70.17	60.05	21.35	60.09	58.09	68.70	81.66	30.81	46.13	29.47	565.37
Mean	19.43	35.09	30.03	10.68	30.05	29.05	34.35	40.83	15.41	23.07	14.74	
II	28.25	25.03	32.46	19.73	13.31	23.26	32.65	48.97	27.06	29.33	6.80	
	22.79	26.35	26.99	24.73	15.89	26.56	37.17	41.67	26.21	34.14	13.18	
Total	51.04	51.38	59.45	44.46	29.20	49.82	69.82	90.64	53.27	63.47	19.98	582.55
Mean	25.52	25.69	29.73	22.23	14.60	24.41	34.91	45.29	26.64	31.74	9.99	
III	29.33	30.33	37.35	23.11	25.70	29.67	39.23	55.30	27.63	22.63	16.74	
	34.39	21.13	41.90	26.78	29.00	31.31	45.80	45.46	21.81	36.45	16.64	
Total	63.72	51.46	79.25	49.89	54.70	60.98	85.03	100.76	49.44	59.08	33.38	687.69
Mean	31.86	25.73	39.63	24.95	27.35	30.49	42.52	50.38	24.72	29.54	16.60	
Total	153.61	173.01	198.75	115.70	143.99	168.89	223.55	273.06	133.52	168.68	82.83	1835.59
Mean	25.63	28.84	33.13	19.28	24.00	28.15	37.26	45.51	22.25	28.11	12.14	
Mean [a]	18.7	23.3	29.9	10.9	16.6	22.3	36.6	50.9	14.3	22.2	4.4	

[a] Represents original data in per cent; L.S.M.D. = 2.20.

Analysis of variance

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR 5%	TABULAR 1%
Blocks	2	398.71	199.35			
Treatments	10	4507.16	450.72	9.17	2.35	3.37
Blocks × treatments	20	983.10	49.15			
Sampling error	33	819.84	24.84			
Total	65	6708.81				

TABLE 2a

Efficacy of five insecticidal sprays based on the number of undamaged stalks

TREATMENT	BLOCK	ROW NUMBER	THREE SPRAYINGS			SIX SPRAYINGS		
			Number of plants to the row	Number of undamaged stalks	Percentage of undamaged stalks	Number of plants to the row	Number of undamaged stalks	Percentage of undamaged stalks
BHC	I	1	63	23	36.5	57	22	38.6
		2	63	34	54.0	57	20	35.1
	II	1	60	34	56.7	62	32	51.6
		2	65	33	50.8	90	41	45.6
	III	1	57	32	56.1	53	24	45.3
		2	73	46	63.0	77	40	51.9
Dieldrin	I	1	61	22	36.1	71	37	52.1
		2	62	41	66.1	69	34	49.3
	II	1	69	50	72.5	88	54	61.4
		2	57	28	49.1	94	45	47.9
	III	1	50	27	54.0	78	38	48.7
		2	50	29	58.0	64	32	50.0
DDT	I	1	61	37	60.7	73	44	60.3
		2	62	30	48.4	65	35	53.8
	II	1	63	41	65.1	56	29	51.8
		2	66	26	39.4	85	36	42.4
	III	1	70	35	50.0	78	50	64.1
		2	56	29	51.8	73	44	60.3

TABLE 2a (continued)

TREATMENT	BLOCK	ROW NUMBER	THREE SPRAYINGS			SIX SPRAYINGS		
			Number of plants to the row	Number of undamaged stalks	Percentage of undamaged stalks	Number of plants to the row	Number of undamaged stalks	Percentage of undamaged stalks
Methoxychlor	I	1	57	20	35.1	58	20	34.5
		2	60	28	46.7	72	21	29.2
	II	1	72	48	66.7	79	40	50.6
		2	57	29	50.9	68	25	36.8
	III	1	50	17	34.0	73	27	37.0
		2	60	29	48.3	66	26	39.4
Lead arsenate	I	1	59	30	50.8	66	29	43.9
		2	68	34	50.0	64	16	25.0
	II	1	53	31	58.5	98	43	43.9
		2	53	22	41.5	70	26	37.1
	III	1	47	20	42.6	63	27	42.9
		2	45	12	26.7	55	27	49.1
Control	I	1	78	21	26.9			
		2	81	19	23.5			
	II	1	62	11	17.7			
		2	52	12	23.1			
	III	1	53	14	26.4			
		2	67	16	23.9			

TABLE 2b

Efficacy of five insecticidal sprays based on the transformed angles of percentages of undamaged stalks

BLOCK	THREE SPRAYINGS					SIX SPRAYINGS					CONTROL	TOTAL
	BHC	Dieldrin	DDT	Methoxy-chlor	Lead arsenate	BHC	Dieldrin	DDT	Methoxy-chlor	Lead arsenate		
I	37.17	36.93	51.18	36.33	45.46	38.41	46.20	50.94	35.97	41.50	31.24	
	47.29	54.39	44.08	43.05	45.00	36.33	44.60	47.18	32.71	30.00	29.00	
Total	84.46	91.32	95.26	79.38	90.46	74.74	90.80	98.12	68.68	71.50	60.24	904.96
Mean	42.23	45.66	47.63	39.69	45.23	37.37	45.40	49.06	34.34	35.75	30.12	
II	48.85	58.37	53.79	54.70	50.07	45.92	51.59	46.03	45.34	41.50	24.88	
	45.46	44.48	38.88	45.46	40.11	42.48	43.80	40.63	37.35	37.52	28.73	
Total	94.31	102.85	92.67	100.16	90.18	88.40	95.39	86.66	82.69	79.02	53.61	965.94
Mean	47.16	51.43	46.34	50.08	45.09	44.20	47.70	43.33	41.35	39.51	26.81	
III	48.50	47.29	45.00	35.67	40.74	42.30	44.25	53.19	37.47	40.92	30.92	
	52.53	49.60	46.03	44.08	31.05	46.09	45.00	50.94	38.88	44.48	29.27	
Total	101.03	96.89	91.03	79.75	71.79	88.39	89.25	104.13	76.35	85.40	60.19	944.20
Mean	50.52	48.45	45.52	39.88	35.90	44.20	44.63	52.07	38.18	42.70	30.10	
Total	279.80	291.06	278.96	259.29	252.43	251.53	275.44	288.91	227.72	235.92	174.04	2815.10
Mean	46.63	48.51	46.49	43.22	42.07	41.92	45.91	48.15	37.95	35.36	29.01	
Mean [a]	52.8	56.1	52.6	46.9	44.9	44.6	51.6	55.5	37.8	40.2	23.5	

[a] Represents original data in per cent; L.S.M.D. = 1.20.

Analysis of variance

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR 5%	TABULAR 1%
Blocks	2	86.83	43.41			
Treatments	10	1957.95	195.79	7.21	2.35	3.37
Blocks × treatments	20	539.61	26.98			
Sampling error	33	852.05	25.81			
Total	65	3436.44				

TABLE 3a

Efficacy of five insecticidal sprays based on the number of plants with undamaged leaves

TREATMENT	BLOCK	ROW NUMBER	THREE SPRAYINGS			SIX SPRAYINGS		
			Number of plants to the row	Number of plants with undamaged leaves	Percentage of plants with undamaged leaves	Number of plants to the row	Number of plants with undamaged leaves	Percentage of plants with undamaged leaves
BHC	I	1	63	19	30.2	57	6	10.5
		2	63	13	20.6	57	12	21.1
	II	1	60	12	20.0	62	14	22.6
		2	65	11	16.9	90	11	12.2
	III	1	57	11	19.3	53	10	18.9
		2	73	17	23.3	77	14	18.2
Dieldrin	I	1	61	20	32.8	71	11	15.5
		2	62	13	21.0	69	16	23.2
	II	1	60	25	36.2	88	37	42.0
		2	57	23	40.4	94	35	37.2
	III	1	50	13	26.0	78	32	41.0
		2	50	16	32.0	64	24	37.5
DDT	I	1	61	23	37.7	73	27	37.0
		2	62	20	32.3	65	21	32.3
	II	1	63	19	30.2	56	16	28.6
		2	66	14	21.2	85	18	21.2
	III	1	70	27	38.6	78	21	26.9
		2	56	28	50.0	73	30	41.1

TABLE 3a (continued)

TREATMENT	BLOCK	ROW NUMBER	THREE SPRAYINGS			SIX SPRAYINGS		
			Number of plants to the row	Number of plants with undamaged leaves	Percentage of plants with undamaged leaves	Number of plants to the row	Number of plants with undamaged leaves	Percentage of plants with undamaged leaves
Methoxychlor	I	1	57	10	17.5	58	11	19.0
		2	60	18	30.0	72	14	19.4
	II	1	72	19	26.4	79	19	24.1
		2	57	10	17.5	68	13	19.1
	III	1	50	9	18.0	73	23	31.5
		2	60	15	25.0	66	27	40.9
Lead arsenate	I	1	59	21	35.6	66	32	48.5
		2	68	16	23.5	64	17	26.6
	II	1	53	10	18.9	70	14	20.0
		2	53	12	22.6	63	15	23.8
	III	1	47	7	14.9	55	11	20.0
		2	45	9	20.0	98	30	30.6
Control	I	1	78	4	5.1			
		2	81	6	7.4			
	II	1	62	8	12.9			
		2	52	8	15.4			
	III	1	53	6	11.3			
		2	67	3	4.5			

TABLE 3b

Efficacy of five insecticidal sprays based on the transformed angles of percentages of plants with undamaged leaves

BLOCK	THREE SPRAYINGS					SIX SPRAYINGS					CONTROL	TOTAL
	BHC	Dieldrin	DDT	Methoxy-chlor	Lead arsenate	BHC	Dieldrin	DDT	Methoxy-chlor	Lead arsenate		
I	33.34 26.99	34.94 27.28	37.88 34.63	24.73 33.21	36.63 29.00	18.91 27.35	23.19 28.79	37.47 34.63	25.84 26.13	44.14 31.05	13.05 15.79	
Total Mean	60.33 30.16	62.22 31.11	72.51 36.26	57.94 28.97	65.63 32.82	46.26 23.13	51.98 25.99	72.10 36.05	51.97 25.99	75.19 37.60	28.84 14.42	644.97
II	26.56 24.27	36.99 39.47	33.34 27.42	30.92 24.73	25.77 28.38	18.91 20.44	40.46 37.58	32.33 27.42	29.40 25.92	26.56 29.20	21.05 23.11	
Total Mean	50.83 25.42	76.46 38.23	60.76 30.38	55.65 27.83	54.15 22.08	39.35 19.68	78.04 39.02	59.75 29.88	55.32 27.66	55.76 27.88	44.16 22.08	630.23
III	26.06 28.86	30.66 34.45	38.41 45.00	25.10 30.00	22.63 26.56	25.77 25.25	39.82 37.76	31.24 39.87	34.14 39.76	26.56 33.58	19.64 12.25	
Total Mean	54.92 27.46	65.01 32.51	83.41 41.71	55.10 27.55	49.19 24.60	51.02 25.51	77.58 38.79	61.11 30.56	73.90 36.95	60.14 30.07	31.89 15.95	663.27
Total	166.08	203.69	216.68	168.69	168.97	136.63	207.60	192.96	181.19	191.09	104.89	1938.47
Mean	27.68	33.95	36.11	28.12	28.16	22.77	34.60	32.16	30.20	31.85	17.48	
Mean[a]	21.6	31.2	34.7	22.2	22.3	15.0	32.2	28.3	25.3	27.8	9.0	

[a] Represents original data in per cent; L.S.M.D. = 1.90.

Analysis of variance

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR 5%	TABULAR 1%
Blocks	2	24.90	12.45			
Treatments	10	1794.96	179.50	4.13	2.35	3.37
Blocks × treatments	20	868.38	43.41			
Sampling error	33	1166.85	35.35			
Total	65	3855.09				

TABLE 4

Effects of five insecticidal sprays on corn earworm

TREATMENT	NUMBER OF LARVAE KILLED AFTER SPECIFIED NUMBER OF HOURS					REMARKS
	22	44	66	88	110	
BHC	2	9	13	15		Larvae fed on treated and untreated ears.
DDT	9	15				Larvae crawled on treated ears but made no attempt at feeding; fed on untreated ears.
Dieldrin	7	13	15			Larvae crawled on treated ears but made no attempt at feeding; fed on untreated ears.
Methoxychlor	0	1	6	12	15	Larvae fed on treated and untreated ears.
Lead arsenate	0	3	11	15		Larvae fed on treated and untreated ears.
Control	0	0	0	0	0	Larvae fed on the ears.

TABLE 5

Effects of five insecticidal sprays on corn stalk borer

TREATMENT	NUMBER OF LARVAE KILLED AFTER SPECIFIED NUMBER OF HOURS					REMARKS
	22	44	66	88	110	
BHC	0	2	8	10		Larvae fed on treated and untreated stalks.
DDT	8	10				Larvae fed on treated and untreated stalks.
Dieldrin	6	10				Larvae fed on treated and untreated stalks.
Methoxychlor	0	3	7	10		Larvae fed on treated and untreated stalks.
Lead arsenate	0	1	4	7	10	Larvae fed on treated and untreated stalks.
Control	0	0	0	0	0	Larvae fed on stalks.

TABLE 6

Effects of five insecticidal sprays on Plusia chalcytes

TREATMENT	NUMBER OF LARVAE KILLED AFTER SPECIFIED NUMBER OF HOURS					REMARKS
	22	44	66	88	110	
BHC	2	8	11	12		Larvae fed on treated and untreated leaves.
DDT	6	12				Larvae fed on treated and untreated leaves.
Dieldrin	8	12				Larvae fed on treated and untreated leaves.
Methoxychlor	1	3	8	10	12	Larvae fed on treated and untreated leaves.
Lead arsenate	0	3	6	11	12	Larvae fed on treated and untreated leaves.
Control	0	0	0	0	0	Larvae fed on leaves.

TABLE 7

Effects of five insecticidal sprays on nymphalid butterfly

TREATMENT	NUMBER OF LARVAE KILLED AFTER SPECIFIED NUMBER OF HOURS					REMARKS
	22	44	66	88	110	
BHC	1	7	9	13	14	Larvae fed on treated and untreated leaves.
DDT	11	14				Larvae fed on treated and untreated leaves.
Dieldrin	7	12	14			Larvae fed on treated and untreated leaves.
Methoxychlor	2	5	9	11	14	Larvae fed on treated and untreated leaves.
Lead arsenate	1	5	7	12	14	Larvae fed on treated and untreated leaves.
Control	0	0	0	0	0	Larvae fed on leaves.

A COMPARISON OF THE EFFICIENCY OF RANDOMIZED BLOCKING AND OF COMPLETE RANDOMIZATION IN POT TESTS [1]

RODOLFO N. PASCUAL

With rice as indicator, estimates of the gain in efficiency of randomized blocking over the completely randomized design ranged from 8 per cent. for panicle length, to 102 per cent, for plant height. Comparisons between the pooled estimates of variance of randomized blocking of the present study and those compiled from the data of five workers who used the completely randomized design showed a gain in efficiency ranging from 58 per cent, for height, to 4505 per cent, for grain yield, in favor of the randomized blocks. The number of replicates necessary to judge a significant mean difference of 1 gram on grain yield was 21 for randomized blocking and 947 for completely randomized design; for a mean difference of 3 grams for straw yield, the number was 7 for randomized blocking and 166 for completely randomized design. Any number of replicates may be computed for any given least significant mean difference.

In replicated experiments conducted in pots, the amount of soil gathered, air-dried, pulverized, and mixed depends upon the size and number of pots used. An experiment consisting of eight treatments, one treatment to a pot replicated seven times, would need a total amount of 173.6 kilograms of soil when medium-sized pots, each containing about 3.1 kilograms, are used. With large pots, each containing about 14.4 kilograms, a total amount of 806.4 kilograms is required. The treatments are allocated to the experimental units or pots in a completely randomized scheme, as in the works of Afenir,[2] Ballesteros,[3] Babaan,[4] Jose,[5] and Felizardo.[6]

---

[1] Central Experiment Station Contribution No. 1792. Thesis presented for graduation, June, 1954, with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agricultural Engineering under the direction of Assistant Professor Burton T. Oñate.

[2] R. A. Afenir, "Growth and Yield of Upland Rice Plants on Lipa Clay Loam with Increased Fertility and Adjusted Soil Reaction." (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture, November, 1949. Unpublished.)

[3] B. Q. Ballesteros, *Philippine Agriculturist*, 35, 207 (1951).

[4] J. F. Babaan, "Effects of Varying Amounts of Potassium on the External Appearance, Dry Matter and Ash Contents of Upland Rice Plant." (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture, April, 1952. Unpublished.)

[5] I. M. Jose, "The Effects of Nitrogen, Phosphorus, and Potassium Added Singly or in Combination to Lipa Clay Loam Planted to Rice." (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture, April, 1953. Unpublished.)

[6] B. C. Felizardo, *Philippine Agriculturist*, 38, 197 (1954).

Can proper blocking increase the efficiency of the design? Cochran and Cox [7] pointed out the principal advantages of randomized blocks. The best method of comparing the efficiency of the randomized blocking arrangement and that of the complete randomization scheme is to subject data obtained from a large number of experimental units to a common treatment.[8] To evaluate the efficiency of the randomized blocking arrangement and that of the complete randomization scheme in pot tests with rice as indicator and to compare the pooled estimated variance with that of a pooled estimate obtained from complete randomized designs, the present study was conducted in the experimental lot of the Department of Soils and in the statistical laboratory of the Department of Agricultural Engineering, College of Agriculture, from May, 1953, to June, 1954.

MATERIALS AND METHODS

Lipa clay loam soil taken from the experimental lot of the Department of Soils and from the experiment station field was divided into seven equal parts, each able to fill one block or replicate. Each part was sifted thoroughly through a one-centimeter mesh sieve and compounded to effect as much homogeneity as possible. The soil was then air-drained for a week for further weathering.

Two sizes of pots—medium and large—were used. The medium-sized pots each contained about 3.1 kilograms of well-processed soil; the large pots, about 14.4 kilograms.

Six sets of pots, each set consisting of 56 pots, were planted to an upland and a lowland variety of Thailand rice. The first set was sown on May 19, 1953. After a week, the plants were thinned to one plant to a pot. Five more sets were sown at one-week intervals to facilitate harvesting, processing of the soil, and refilling of the pots.

The following characteristics were observed: (1) weight of the plants at maturity, (2) air-dry weight of the grains, (3) air-dry weight of the straw, and (4) length of the panicles.

THEORETICAL CONSIDERATIONS

Let there be s sets of experiments of bt units (pots). Each set is divided into b blocks (replications) of t units (treatments). The soil for each block has been mixed separately and thoroughly. This will be the basis for the use of blocks.[9] Thus, for eight treatments, only about 24.8 kilograms of soil for the medium-sized pots will be mixed at a time for each block ($b = 1$) and not 173.6 kilograms for seven blocks ($b = 7$).

---

[7] W. G. Cochran and G. M. Cox, "Experimental Design," New York, John Wiley and Sons, Inc., 1950, 454 pp.

[8] O. Kempthorne, "The Design and Analysis of Experiments," New York, John Wiley and Sons, Inc., 1952, 631 pp.

[9] B. T. Oñate, *Philippine Agriculturist*, 36, 395 (1953).

The analysis of the observations, say, on yield, follows:

Analysis of variance I

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	
Sets	$s-1$		
Blocks within sets	$s(b-1)$	B	(1)
Units within blocks	$sb(t-1)$	E	
Total	$sbt-1$		

The mean square E is an estimate of the experimental error σ^2 with randomized blocks of t plots, and B is an estimate of the variance between blocks within the experiments.

For a single experiment ($s = 1$) with pseudo-treatments the analysis is as follows:

Analysis of variance II

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	
Blocks	$b-1$	$(b-1)B$	
Within blocks	$b(t-1)$	$b(t-1)E$	(2)
Total	$bt-1$	$(b-1)B + b(t-1)E$	

Thus, in an experiment without blocks, the variances of treatment comparisons would be proportional to the total mean square, or

$$V(\bar{x}) = \frac{(b-1)B + b(t-1)E}{bt-1}. \qquad (3)$$

With blocks, $V(\bar{x})$ is proportional to E.

The relative efficiency of the use of blocks over complete randomization is calculated from

$$R.E. = \frac{(b-1)B + b(t-1)E}{(bt-1)E}$$

In general, B would be greater than E.

EXPERIMENTAL RESULTS AND DISCUSSION

Analyses of variance I and II were computed for height, yields of grain and straw, and length of panicles (tables 1a to 4b). The following values were used: $s = 6$, $b = 7$, and $t = 8$.

The relative efficiency for height of the randomized blocking arrangement over that of the completely randomized scheme is computed from equations 3 and 4. Thus, from tables 1a and 1b, the variance of a treatment mean without blocks would be proportional to the total mean square

$$V(\bar{x}) = \frac{6(568.25) + 7(8-1)54.90}{56-1}$$

$$= \frac{3409.50 + 2690.10}{55}$$

$$= \frac{6099.60}{55}$$
$$= 110.90$$

and with blocks,

$$V(x) = 54.90. \qquad (1)$$

The relative efficiency in per cent is then

$$R.E. = \frac{110.90}{54.90} \times 100 = 202.00 \text{ per cent},$$

or a gain of 102 per cent in favor of the blocking arrangement.

Similarly, the relative efficiency for each of the three remaining plant characteristics may be computed from their respective analyses of variance (table 5). A comparison of the values of B and E for each plant characteristic showed that B is always greater than E, as may be expected. These four estimates of gain in efficiency imply that from 8 to 102 per cent more information may be obtained from a mean of a randomized blocking arrangement than from a mean of a completely randomized scheme. In terms of replication, say, in height, randomized blocking will require less than one-half the number of replicates than complete randomization to obtain the same amount of information. Goulden [10] noted that the success of the randomized block experiment depends to a considerable degree on the skill of the researcher in setting up the plan so that the replicates or blocks coincide with some major source of variability, such as fertility, time, position, and classification of experimental material.

Since one of the assumptions underlying the technique of analysis of variance is that of additivity, it would be interesting to compare the pooled estimates of variance of a randomized blocking arrangement with the pooled estimates of variance of completely randomized designs. The latter estimates were obtained from the works of Afenir, Ballesteros, Babaan, Jose, and Felizardo. Comparisons of these estimates and the corresponding efficiencies obtained for three plant characteristics indicate considerable gains in efficiency, especially in the measurements for yields of grain and straw (table 6).

The significance of these results may be discussed from the point of view of size of sample or replicate necessary to conclude a comparison significant. Given a number of replicates, how large should the difference be for it to be judged significant? Consider the relationship

Least significant mean difference (L.S.M.D.) =

$$t_{.05,\text{d.f.}}\sqrt{\frac{2E}{n}}$$

where $t_{.05,\text{d.f.}}$ = theoretical t-value at 5 per cent level and with d.f. degrees of freedom
E = error variance from their respective pooled estimates
n = size of sample that makes up a mean.

[10] G. H. Goulden, "Methods of Statistical Analysis," New York, John Wiley and Sons, Inc., 1952, 467 pp.

The L.S.M.D. necessary to conclude a difference may be computed for the two designs. These results are shown in table 7 with $t.05$, d.f. $= 2$, and $n = 8$.

Also, from the equation

$$\text{L.S.M.D.} = t_{.05,\text{d.f.}}\frac{2E}{n}$$

we may solve for n, the size of sample or replicate:

$$n = \frac{2(t_{.05,\text{d.f.}})^2 E}{(\text{L.S.M.D.})^2}$$

Considerable sizes are necessary in the completely randomized design to detect differences of 2 centimeters for height, 1 gram for yield of grain, and 3 grams for yield of straw (table 8). The randomized block design, being more efficient, has the practical importance of controlling error. By and large, randomized blocks will result in a minimum variance as compared with the completely randomized designed. Other values of L.S.M.D. may be used to compute for the size of sample necessary to detect significant differences.

An important point to consider in combining experiments is the assumption on the homogeneity of variance. Bartlett's test [11] may be carried out to test homogeneity. If variances are homogeneous, then the different variances may be pooled together for the F-test.

[11] G. W. Snedecor, "Statistical Methods," Ames, Iowa, The Collegiate Press, Inc., 1946, 485 pp.

TABLE 1a

Analysis of variance I on height

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE
Sets	5	30,918.90	6,183.78
Blocks within sets ..	34	19,320.40	568.25
Pots within blocks ..	279	15,318.02	54.90
Total [a]	318	65,557.32	

[a] Two blocks and one pot missing.

TABLE 1b

Analysis of variance II

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES
Blocks	6	3,409.50
Within blocks	49	2,690.10
Total	55	6,099.60

TABLE 2a

Analysis of variance I on yield of grain

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE
Sets	5	5,941.73	1,188.35
Blocks within sets ..	34	753.98	22.18
Pots within blocks ..	279	715.45	2.56
Total [a]	318	7,411.16	

[a] Two blocks and one pot missing.

TABLE 2b

Analysis of variance II

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES
Blocks	6	133.08
Within blocks	49	125.93
Total	55	259.01

TABLE 3a

Analysis of variance I on dry weight of straw

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE
Sets	5	5,195.78	1,039.16
Blocks within sets ..	34	1,910.68	56.20
Pots within blocks ..	279	2,204.37	7.90
Total [a]	318	9,310.83	

[a] Two blocks and one pot missing.

TABLE 3b

Analysis of variance II

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES
Blocks	6	337.20
Within blocks	49	387.10
Total	55	724.30

TABLE 4a

Analysis of variance I on length of panicles

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE
Sets	5	1,703.28	340.66
Blocks within sets	34	176.81	5.20
Pots within blocks	280	829.76	2.96
Total [a]	319	2.709.85	

[a] Two blocks missing.

TABLE 4b

Analysis of variance II

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES
Blocks	6	31.20
Within blocks	49	145.04
Total	55	176.04

TABLE 5

Relative efficiency of randomized block over complete randomization scheme

CHARACTERISTIC	VARIANCE WITH BLOCKS	VARIANCE WITHOUT BLOCKS	$\frac{\text{VARIANCE WITH BLOCKS}}{\text{VARIANCE WITHOUT BLOCKS}} \times 100$	GAIN IN RELATIVE EFFICIENCY
			per cent	*per cent*
Height	110.90	54.90	202.00	102.00
Yield of grain	4.71	2.57	183.27	83.27
Dry weight of straw	13.17	7.90	166.71	66.71
Length of panicle	3.20	2.96	108.11	8.11

TABLE 6

Estimates of variances from the two types of design

PLANT CHARACTERISTIC	ESTIMATES FROM COMPLETELY RANDOMIZED DESIGNS [a]		ESTIMATES FROM RANDOMIZED BLOCKING [b]		$\frac{\text{VARIANCE WITHOUT BLOCKS}}{\text{VARIANCE WITH BLOCKS}} \times 100$	GAIN IN RELATIVE EFFICIENCY
	DF	Variance	DF	Variance		
					per cent	*per cent*
Height	158	86.76	279	54.90	158.03	58.03
Yield of grain	169	118.35	279	2.57	4,605.06	4,505.06
Yield of straw	128	189.36	279	7.90	2,396.96	2,296.96

[a] Data compiled from the works of Afenir, Ballesteros, Babaan, Jose, and Felizardo.
[b] Experimental data of the author.

TABLE 7

Least significant mean difference (L.S.M.D.) for the two types of design with fixed t and n

CHARACTERISTIC	*t*	*n*	COMPLETELY RANDOMIZED DESIGN	RANDOMIZED BLOCKING
Height	2	8	9.31	7.41
Yield of grain ...	2	8	10.88	1.60
Yield of straw ...	2	8	13.76	2.81

TABLE 8

Size of sample necessary to detect a given L.S.M.D. with t-value fixed for the two types of design

CHARACTERISTIC	L.S.M.D.	*t*	SIZE OF SAMPLE	
			Completely randomized design	Randomized blocking
Height	2 cm.	2	173.52	109.80
Yield of grain ...	1 gram	2	946.80	20.56
Yield of straw ...	3 grams	2	165.65	7.02

THE PRESENCE OF TRICHOMES ON TEN VARIETIES OF KENAF [1]

MIGUEL C. SISON

Maceo F_1, Cubano F_1, Cuba 797–11 F_1, Tingo Maria F_1, Java F_1, Salvador Selection 3–A F_1, Formosa Selection 3–B F_1, Viridis College Selection F_7, Vulgaris College Selection F_7, and Barretto (local) F_1 were examined for the presence of trichomes on the pods, bark, and leaves. Java F_1, Formosa Selection 3–B F_1, and Maceo F_1 had the least trichomes of the 10 varieties and can be recommended for further selection. Java F_1 had practically no trichomes on the bark. Maceo F_1 had the least number of trichomes on the pods and on the leaves.

Kenaf (*Hibiscus cannabinus* Linn.) has one objectionable characteristic, and that is it has trichomes on almost every plant part. The itchy effect of these trichomes lessens the efficiency of the harvesters so that harvesting is the most expensive phase of kenaf production. A study was therefore conducted to determine which of the 10 outstanding varieties of kenaf have the least trichomes. The work took place from June, 1953, to March, 1954, in the Central Experiment Station and in the Department of Agronomy, College of Agriculture.

MATERIALS AND METHODS

Germination test. Seeds of Cubano F_1 (CA 766), Maceo F_1 (CA 768), and Java F_1 (CA 770) from Cuba and Cuba 797-11 F_1 (CA 767), Tingo Maria F_1 (CA 769), Salvador Selection 3-A F_1 (CA 771), Formosa Selection 3-B F_1 (CA 772), Viridis College Selection F_7 (CA 777), Vulgaris College Selection F_7 (CA 778), and Barretto (local) F_1 (CA 886) from Soriano y Cia., Manila, were tested before planting in the field. One hundred seeds of each variety were planted in soil contained in a paper box on June 26, 1953. Seeds that germinated after four days were counted to determine the percentage of germination.

Preparation of the land. The culture area was 30 meters long and 11 meters wide of well-drained, fairly fertile clay loam soil. It was plowed and harrowed twice during the last week of June, 1953, and was divided into three blocks of 10 plots each to provide a plot for every variety. Meter-wide paths between blocks and 60-centimeter spaces between plots were made. Each plot was 3 meters long and 3 meters wide, or 9 square meters in area.

Planting. The seeds were planted on July 2, 1953, following a randomized block design. Shallow furrows 60 centimeters apart were made in a block. Each furrow had five hills 60 centimeters apart,

[1] Central Experiment Station Contribution No. 1793. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1954. Prepared in the Department of Agronomy under the direction of Associate Professor Pedro A. David.

making a total of 25 hills for every variety in a block. Since the percentage of germination was satisfactory, only two seeds were planted to a hill. The plants were thinned to only one plant to a hill two weeks after planting.

Weeding and cultivation. The planted blocks were weeded two weeks after planting and lightly cultivated with a trowel. They were weeded and cultivated every two weeks thereafter until the plants started to flower.

Counts and measurements. The nine plants at the middle of each plot which were least influenced, if at all, by the surrounding spaces were measured for height during the full blooming period (113 to 135 days after planting) and when they were 197 days old.

The branches of each plant were counted during the full blooming period and when the plants were 197 days old. The final count was used in computing the average number of branches. Flowering stalks were counted separately.

Pods were counted when mature. They were measured for length and diameter.

From nine plants of each variety in a block three representative parts of the plant—the pod, the bark, and the leaf—were analyzed for the presence of trichomes just before the lowest pod became dry. The number of trichomes on each part was counted with the aid of a dissecting microscope.

The lowest pod of the plant was examined for trichomes. The trichomes present on one bracteole were counted and the number for every square centimeter was computed. Ten-centimeter portions of the bark were cut from the stem 1½ feet from the ground. Leaf trichomes were taken from the petiole of the middle leaf of the plant 1 centimeter from the blade. Ten trichomes from each representative part were scraped off with a razor blade and measured for length and diameter under low power of an ocular micrometer.

RESULTS AND DISCUSSION

Percentage of germination and general appearance of the plants. Cubano F_1, Cuba 797-11 F_1, Maceo F_1, Java F_1, and Salvador Selection 3-A F_1 gave 100 per cent germination; Tingo Maria F_1, Formosa Selection 3-B F_1, and Barretto (local) F_1, 99 per cent; Vulgaris College Selection F_7, 98 per cent; and Viridis College Selection F_7, 87 per cent (table 1). The seeds planted in the field germinated two to four days after sowing as there was sufficient moisture in the soil.

The different varieties exhibited marked differences in color and form of leaves, color of stems, and rate of growth from germination to maturity. Cubano F_1, Cuba 797-11 F_1, Salvador Selection 3-A F_1, Viridis College Selection F_7, and Barretto F_1 had green stems and entire green leaves; Java F_1 and Formosa Selection 3-B, purple stems with divided purplish-green leaves; Maceo F_1, light-purple

stems with entire greenish-brown leaves; and Vulgaris College Selection F_7, green stems with divided green leaves (table 1).

Java F_1 and Formosa Selection 3-B F_1 grew very slowly during the first two weeks after planting unlike the other varieties. These two varieties, however, attained heights comparable with those of the other varieties at the blooming period.

Susceptibility to pests and diseases. All the varieties were attacked by pests and a fungous disease (table 1). *Nisotra gemella* Erich.[2] and *Dysdercus megalopygus* Breddin attacked the plants two months after planting. Salvador Selection 3-A F_1 was most severely infested by the two pests, whereas the nine varieties were only slightly infested. The insects were controlled by hand-picking and spraying with Gesarol (25 per cent DDT) every two weeks. Phoma blight caused by *Phoma sabdariffae* Sacc.[3] infested all the varieties slightly.

Age and height of plants at blooming stage. The blooming age of the plants ranged from 113 to 135 days after planting (table 2). The differences in mean height of some of the varieties at blooming time were significant. Cubano F_1 produced the tallest plants which were not statistically different from those of Cuba 797-11 F_1, Maceo F_1, Tingo Maria F_1, and Java F_1, but which were statistically different from those of Viridis College Selection F_7, Salvador Selection 3-A F_1, Formosa Selection 3-B F_1, and Vulgaris College Selection F_7. Barretto (local) F_1 gave the lowest mean, which was significantly lower than the means of the first six ranking varieties (table 2).

Height of plants at maturity. The mean heights of the plants 197 days after planting, when all the plants had matured for seed production, were significantly different. Cubano F_1 was the tallest; Barretto (local) F_1 was the shortest (table 3).

Average number of branches. Cuba 797-11 F_1 gave the highest average number of branches, followed by Vulgaris College Selection F_7, Java F_1, Formosa Selection 3-B F_1, Barretto (local) F_1, and Salvador Selection 3-B F_1. The difference in mean number of branches between the first two varieties was significant, but the differences among the last five varieties were insignificant. Maceo F_1 produced the least number of branches.

Number of flowering stalks. Great variations in mean count of flowering stalks were noted. Vulgaris College Selection F_7 had the greatest number, which was significantly greater than that of Java F_1, which ranked second, or of Barretto (local) F_1 and Salvador Selection 3-A F_1. The difference between the mean of Salvador Selection 3-A F_1 and the mean of either of the six remaining varieties was significant. Tingo Maria F_1 produced quite a number of branches but no flowers (table 5).

---

[2] All insects mentioned in this report were identified by Dr. Silverio M. Cendaña of the Department of Entomology.

[3] Identified by Mrs. Victoria Mendiola Ela of the Department of Plant Pathology.

Number of pods. While Cubano F_1 produced the most pods, the difference between its mean and those of Barretto (local) F_1 and Maceo F_1 was not significant. It produced significantly more pods than Salvador Selection 3-A F_1, Vulgaris College Selection F_7, and Java F_1. Tingo Maria F_1 gave the least number of pods, an average of only two to a plant (table 6a).

Length and width of pods. The pods of Cubano F_1 were first in length but fourth in width; those of Salvador Selection 3-A F_1 ranked second in length and width. Vulgaris College Selection F_7 pods were fifth in length but were the widest. Barretto (local) F_1, Java F_1, and Viridis College Selection F_7 had significantly shorter pods than the first seven varieties (tables 6b and 6c).

Trichomes on the pods. Maceo F_1 had the least number of trichomes on the pods. The differences of the means of Formosa Selection 3-B F_1, Java F_1, Cuba 797-11 F_1, Tingo Maria F_1, and Salvador Selection 3-A F_1 were significantly less than those of the means of Cubano F_1, Viridis College Selection F_7, and Barretto (local) F_1 (table 7a). The trichomes of the different varieties also varied in length and in diameter. The trichomes of Viridis College Selection F_7, Vulgaris College Selection F_7, Maceo F_1, Java F_1, and Salvador Selection 3-A F_1 were significantly shorter and smaller in diameter than those of Tingo Maria F_1, Formosa Selection 3-B F_1, Cubano F_1, and Cuba 797-11 F_1. The differences among the means of Viridis College Selection F_7, Vulgaris College Selection F_7, Maceo F_1, Java F_1, and Salvador Selection 3-A F_1 were significant (tables 7b and 7c).

Trichomes on the bark. The plants differed greatly in number of trichomes on the bark. Vulgaris College Selection F_7 had the most trichomes, and Java F_1 had the least (table 8). Tingo Maria F_1 produced the longest trichomes, and Cubano F_1 produced the broadest trichomes. The differences between the longest and the shortest and between the broadest and narrowest trichomes were highly significant (tables 8b and 8c).

Trichomes on the leaves. The mean count of trichomes for every square centimeter on the leaves varied significantly. Maceo F_1 had the least number of trichomes. Salvador Selection 3-A F_1 had the shortest and narrowest trichomes. These two varieties differed significantly in number, length, and diameter of trichomes (tables 9a, 9b, and 9c).

TABLE 1

Percentage germination, general vigor, and external characteristics of the plants

VARIETY	GERMINATION [a]	GENERAL VIGOR		EXTERNAL CHARACTERISTICS		
		Susceptibility to pests	Susceptibility to diseases	Leaf: Shape	Leaf: Color	Color of stem
	per cent					
CA 768	100	very slight	slight	entire	greenish brown	light purple
CA 766	100	slight	"	entire	green	green
CA 767	100	"	"	entire	green	green
CA 769	99	"	"	entire	greenish purple	dark purple
CA 770	100	"	"	divided	purplish green	purple
CA 771	100	high	"	entire	green	green
CA 772	99	slight	"	divided	purplish green	purple
CA 777	87	"	"	entire	green	green
CA 778	98	"	"	divided	green	green
CA 886	99	"	"	entire	green	green

[a] Based on 100 seeds.

TABLE 2

Age and height of the plants at full blooming time

VARIETY	AGE AT FULL BLOOMING [a]	HEIGHT OF PLANTS AT FULL BLOOMING				
		Replication			Total	Mean
		I	II	III		
	days	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*
CA 768	113	203.06	182.56	253.44	639.06	213.02
CA 766	120	259.33	239.17	251.61	750.11	250.04
CA 767	135	199.11	213.33	236.66	649.10	216.37
CA 769	125	209.11	196.86	209.44	615.41	205.14
CA 770	125	179.94	210.44	219.33	609.71	203.24
CA 771	113	215.33	196.28	184.64	596.25	198.75
CA 772	125	172.56	194.89	189.33	556.78	185.59
CA 777	113	262.33	176.94	166.33	605.60	201.87
CA 778	120	171.22	157.94	164.39	493.55	164.52
CA 886	113	161.44	151.17	162.17	474.78	158.26
		2033.43	1919.58	2037.34	5990.35	

[a] The number of days was computed when more than 50 per cent of the flowers of a variety had opened.

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	894.82	447.41	3.68		
Varieties	9	18572.33	2063.59		2.46	3.60
Error	18	10102.39	561.24			
Total	29	29569.54				

L.S.M.D. = 40.55

TABLE 3

Height of the plants at maturity [a]

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
	cm.	*cm.*	*cm.*	*cm.*	*cm.*
CA 768	259.80	253.33	299.35	812.48	270.83
CA 766	287.78	265.24	275.65	828.67	276.22
CA 767	244.21	250.38	269.78	764.37	254.79
CA 769	261.95	269.42	278.19	809.56	269.85
CA 770	251.45	252.00	252.90	756.35	252.12
CA 771	226.10	236.70	213.70	676.50	225.50
CA 772	207.35	203.77	227.25	638.37	212.79
CA 777	229.78	216.12	223.06	668.96	222.99
CA 778	251.00	227.56	227.56	706.12	235.36
CA 886	217.33	187.11	210.44	614.88	204.96
Total	2436.75	2361.63	2477.88	7276.26	

[a] Determined when the plants were 197 days old.

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	694.96	347.48			
Varieties	9	17831.61	1981.29	12.57	2.46	3.60
Error	18	2836.52	157.58			
Total	29	21363.09				

L.S.M.D. = 21.43

TABLE 4

Number of branches at maturity (197 days)

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
CA 768	1.22	0.78	0.78	2.78	0.93
CA 766	1.56	3.78	3.11	8.45	2.82
CA 767	9.33	9.56	9.00	27.89	9.30
CA 769	4.33	3.44	2.44	10.21	3.40
CA 770	2.78	6.33	7.89	17.00	5.67
CA 771	4.78	2.89	7.75	15.42	5.14
CA 772	4.00	5.63	6.44	16.07	5.36
CA 777	5.33	4.33	1.89	11.55	3.85
CA 778	4.44	7.56	5.57	17.57	5.86
CA 886	3.89	4.67	7.00	15.56	5.19
Total	41.66	48.97	51.87	142.50	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	5.53	2.77			
Varieties	9	133.28	14.81	6.00	2.46	3.60
Error	18	44.43	2.47			
Total	29	183.24				

L.S.M.D. = 2.69

TABLE 5

Number of flowering stalks

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
CA 768	0.22	0.00	0.33	0.55	0.18
CA 766	0.22	0.33	0.67	1.22	0.41
CA 767	0.67	0.00	0.00	0.67	0.22
CA 769	0.00	0.00	0.00	0.00	0.00
CA 770	0.67	1.78	3.44	5.89	1.96
CA 771	1.67	0.78	2.25	4.70	1.57
CA 772	1.00	0.88	1.11	2.99	1.00
CA 777	1.89	0.33	0.00	2.22	0.74
CA 778	2.89	2.33	2.29	7.51	2.50
CA 886	1.22	1.44	2.89	5.55	1.85
Total	10.45	7.87	12.98	31.30	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					1%	5%
Blocks	2	1.30	0.65			
Varieties	9	20.70	2.30	5.11	2.46	3.60
Error	18	8.09	0.45			
Total	29	30.09				

L.S.M.D. = 1.15

TABLE 6a

Number of pods

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
CA 768	41.66	49.67	62.00	153.33	51.11
CA 766	64.89	63.33	68.00	196.22	65.41
CA 767	24.44	29.00	22.00	75.44	25.15
CA 769	2.22	2.44	1.33	5.99	2.00
CA 770	49.78	50.11	28.66	128.55	42.85
CA 771	44.67	54.78	45.25	144.70	48.23
CA 772	26.22	20.75	19.67	66.64	22.21
CA 777	55.22	40.11	16.89	112.22	37.41
CA 778	63.33	30.22	42.85	136.40	45.47
CA 886	63.89	62.89	46.22	173.00	57.67
Total	436.32	403.30	352.87	1192.49	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	353.25	176.63			
Varieties	9	9522.53	1058.06	10.66	2.46	3.60
Error	18	1786.17	99.23			
Total	29	11661.95				

L.S.M.D. = 17.08

TABLE 6b

Length of pods

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
	cm.	*cm.*	*cm.*	*cm.*	*cm.*
CA 768	2.83	3.02	2.35	8.20	2.73
CA 766	2.93	3.02	2.87	8.82	2.94
CA 767	3.10	2.57	2.80	8.47	2.82
CA 769	2.33	2.11	2.25	6.69	2.23
CA 770	2.02	2.72	2.21	6.95	2.32
CA 771	2.83	2.66	3.03	8.52	2.84
CA 772	2.49	2.42	2.81	7.93	2.64
CA 777	2.24	2.82	2.26	6.92	2.31
CA 778	2.73	2.42	2.89	8.44	2.81
CA 886	2.54	2.63	2.68	7.64	2.55
Total	26.04	26.39	26.15	78.58	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	0.003	0.0015			
Varieties	9	1.77	0.20	4.00	2.46	3.60
Error	18	0.857	0.05			
Total	29	2.63				

L.S.M.D. = 0.38

TABLE 6c

Width of pods

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
	cm.	*cm.*	*cm.*	*cm.*	*cm.*
CA 768	1.82	1.70	1.63	5.15	1.72
CA 766	1.78	1.81	1.77	5.36	1.79
CA 767	1.53	1.69	1.66	4.88	1.63
CA 769	1.64	1.62	1.55	4.81	1.60
CA 770	1.64	1.72	1.66	5.02	1.67
CA 771	1.89	1.77	1.95	5.61	1.87
CA 772	1.76	1.76	1.72	5.24	1.75
CA 777	1.84	1.89	1.83	5.56	1.85
CA 778	1.92	1.94	1.90	5.76	1.92
CA 886	1.81	1.69	1.82	5.32	1.77
Total	17.63	17.59	17.49	52.71	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	0.001	0.0005			
Varieties	9	0.302	0.034	8.50	2.46	3.60
Error	18	0.067	0.004			
Total	29	0.370				

L.S.M.D. = 0.11

TABLE 7a

Number of trichomes on the pods for every square centimeter

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
CA 768	40.22	38.36	49.61	128.19	42.73
CA 766	206.65	80.07	108.14	394.86	131.62
CA 767	57.55	78.27	73.49	209.31	69.77
CA 769	79.98	90.25	86.11	256.34	85.45
CA 770	46.04	66.27	67.87	180.18	60.06
CA 771	110.53	121.32	76.23	308.08	102.69
CA 772	67.71	51.57	45.40	164.68	54.89
CA 777	178.59	169.14	153.83	501.56	167.19
CA 778	115.04	95.49	109.46	319.99	106.66
CA 886	189.42	256.05	224.76	670.23	223.41
Total	1091.73	1046.79	994.90	3133.42	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	469.61	234.81			
Varieties	9	85899.27	9544.36	13.06	2.46	3.60
Error	18	13137.97	729.88			
Total	29	99506.85				

L.S.M.D. = 46.22

TABLE 7b

Length of trichomes on the pods in microns

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
CA 768	910.63	953.06	931.85	2795.54	931.85
CA 766	1285.16	1235.15	1260.39	3780.70	1260.23
CA 767	1021.66	1048.64	1042.81	3113.11	1037.70
CA 769	881.24	793.55	902.46	2577.25	859.08
CA 770	980.20	937.38	965.43	2883.01	961.00
CA 771	855.98	819.43	854.16	2529.57	843.19
CA 772	816.58	910.48	732.29	2459.35	819.78
CA 777	988.12	980.14	983.11	2951.37	983.79
CA 778	964.71	951.93	956.17	2872.81	957.60
CA 886	967.90	838.32	960.10	2666.32	888.77
Total	9672.18	9468.08	9488.77	28629.03	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	2524.25	1262.13			
Varieties	9	437343.31	48593.70	25.63	2.46	3.60
Error	18	34128.46	1896.03			
Total	29	473996.02				

L.S.M.D. = 74.58

TABLE 7c

Diameter of trichomes on the pods in micron

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
CA 768	92.86	110.14	99.43	302.43	100.81
CA 766	136.33	109.48	114.00	359.81	119.94
CA 767	120.65	111.82	121.12	353.59	117.86
CA 769	114.74	104.69	119.57	339.00	113.00
CA 770	100.18	100.46	107.18	307.82	102.61
CA 771	115.96	101.78	110.85	328.59	109.53
CA 772	115.04	111.62	108.09	334.75	111.58
CA 777	97.12	87.13	91.92	276.17	92.06
CA 778	95.22	93.42	94.08	282.72	94.24
CA 886	97.44	95.70	97.16	290.30	96.77
Total	1085.54	1026.24	1063.40	3175.18	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	179.59	89.80			
Varieties	9	2651.29	294.59	6.90	2.46	3.60
Error	18	768.09	42.67			
Total	29	3598.97				

L.S.M.D. = 11.20

TABLE 8a

Number of trichomes on the bark for every square centimeter

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
CA 768	0.35	0.35	0.22	0.92	0.31
CA 766	0.74	0.36	0.62	1.72	0.57
CA 767	0.46	0.30	0.43	1.19	0.40
CA 769	0.26	0.17	0.37	0.80	0.27
CA 770	0.10	0.04	0.02	0.16	0.05
CA 771	0.28	0.69	0.48	1.45	0.48
CA 772	0.08	0.08	0.04	0.20	0.07
CA 777	0.82	0.01	1.08	1.91	0.64
CA 778	1.04	1.22	1.27	3.53	1.18
CA 886	0.70	0.81	0.79	2.30	0.77
Total	4.83	4.03	5.32	14.18	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	0.08	0.04			
Varieties	9	3.11	0.35	7.00	2.46	3.60
Error	18	0.83	0.05			
Total	29	4.02				

L.S.M.D. = 0.38

TABLE 8b

Length of trichomes on the bark in microns

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
CA 768	372.35	377.06	394.22	1143.63	381.21
CA 766	583.60	367.67	391.02	1342.29	447.43
CA 767	380.62	477.17	465.85	1323.64	441.21
CA 769	524.65	532.24	558.52	1615.41	538.47
CA 770	465.31	475.88	502.78	1443.97	481.32
CA 771	365.93	501.26	404.09	1271.28	423.76
CA 772	375.55	365.48	339.08	1081.11	360.37
CA 777	486.33	390.21	483.99	1360.53	453.51
CA 778	438.94	413.14	422.51	1274.59	424.86
CA 886	464.20	488.40	444.79	1397.39	465.80
Total	4458.48	4388.51	4406.85	13253.84	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	263.26	131.63			
Varieties	9	67699.41	7522.16	2.56	2.46	3.60
Error	18	52824.97	2934.72			
Total	29	120787.64				

L.S.M.D. = 92.86

TABLE 8c

Diameter of trichomes on the bark in microns

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
CA 768	164.82	139.02	149.32	453.16	151.05
CA 766	153.11	213.76	219.66	586.53	195.51
CA 767	151.10	140.09	136.10	427.29	142.43
CA 769	166.67	150.68	152.52	469.87	156.62
CA 770	131.04	147.88	139.43	418.35	139.45
CA 771	158.78	155.18	160.69	474.65	158.22
CA 772	133.39	117.61	133.09	384.09	128.03
CA 777	166.43	159.47	156.98	482.89	160.96
CA 778	173.15	152.63	158.29	484.07	161.36
CA 886	167.49	174.55	170.28	512.32	170.77
Total	1565.98	1550.87	1576.37	4693.22	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	32.89	16.45			
Varieties	9	9302.46	1033.61	4.76	2.46	3.60
Error	18	3910.48	217.25			
Total	29	13245.83				

L.S.M.D. = 25.29

TABLE 9a

Number of trichomes on the leaves for every square centimeter

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
CA 768	8.73	5.55	9.31	23.59	7.86
CA 766	10.97	14.92	14.23	40.12	13.37
CA 767	7.13	14.39	11.48	33.00	11.00
CA 769	24.63	17.08	14.87	56.58	18.86
CA 770	18.09	12.60	13.34	44.03	14.68
CA 771	19.43	18.52	20.61	58.56	19.52
CA 772	9.94	16.93	10.41	37.28	12.43
CA 777	34.80	35.12	29.30	99.22	33.07
CA 778	18.94	19.96	19.41	58.31	19.44
CA 886	18.03	29.27	22.29	69.59	23.20
Total	170.69	184.34	165.25	520.28	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	19.34	9.67			
Varieties	9	1410.81	156.75	13.21	2.46	3.60
Error	18	213.64	11.87			
Total	29	1643.79				

L.S.M.D. = 5.92

TABLE 9b

Length of trichomes on the leaves in microns

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
CA 768	301.55	302.70	288.81	893.06	297.69
CA 766	371.54	424.18	464.27	1259.99	420.00
CA 767	362.99	379.56	379.88	1121.43	373.81
CA 769	413.73	363.11	348.25	1125.09	375.03
CA 770	340.16	374.24	404.15	1118.55	372.85
CA 771	199.76	315.28	162.08	677.12	225.71
CA 772	383.17	374.00	373.21	1130.38	376.79
CA 777	419.01	407.48	417.06	1243.55	414.52
CA 778	384.44	390.73	398.47	1173.64	391.21
CA 886	438.09	400.09	417.36	1255.54	418.51
Total	3614.44	3730.37	3653.54	10998.35	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	695.74	347.87			
Varieties	9	99942.00	11104.67	9.07	2.46	3.60
Error	18	22037.75	1224.32			
Total	29	122675.49				

L.S.M.D. = 59.88

TABLE 9c

Diameter of trichomes on the leaves in microns

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
CA 768	94.42	131.36	118.57	344.35	114.78
CA 766	148.85	131.38	134.57	414.80	138.27
CA 767	109.89	85.91	96.04	291.84	97.28
CA 769	133.14	120.96	127.81	381.91	127.30
CA 770	106.19	107.41	108.02	321.62	107.21
CA 771	80.08	98.49	70.64	249.21	83.07
CA 772	105.71	99.50	93.60	298.81	99.60
CA 777	122.06	106.94	109.95	338.95	112.98
CA 778	106.94	112.57	108.68	328.19	109.40
CA 886	139.03	96.08	111.78	346.89	115.63
Total	1146.31	1090.60	1079.66	3316.57	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F	
					5%	1%
Blocks	2	364.56	182.28			
Varieties	9	6595.39	732.82	5.40	2.46	3.60
Error	18	2442.33	135.68			
Total	29	9402.28				

L.S.M.D. = 19.96

FEEDING AUROFAC TO 12-WEEK-OLD PULLETS RANGE-REARED TO 24 WEEKS OF AGE [1]

FRANCISCO C. SALINAS

The addition of 1 gram Aurofac to every 100 grams of the College rearing ration markedly improved the feeding value of the ration. The pullets given Aurofac-supplemented feed were heavier than the control birds from the 13th week to the close of the experiment. Mortality in the control lot was consistently higher than in the experimental lot. In cost of feed to produce a kilogram gain in weight the Aurofac-supplemented feed was also the better ration.

Numerous studies have been reported on the influence of Aurofac [2] on the growth and livability of growing chicks, but so far, very few studies have been made on its influence on weanlings. To find out whether or not beneficial results would still be gained by incorporating Aurofac in the College rearing ration for 12-week-old pullets range-reared to 24 weeks of age, this study was conducted in the poultry laboratory of the Department of Animal Husbandry from January, 1953, to December, 1953.

MATERIALS AND METHODS

Two hundred eighty 12-week-old New Hampshire weanlings were wingbanded and distributed at random into two lots. Three trials were conducted, each covering a period of 12 weeks. In trials 1 and 3, 50 weanlings were assigned to each lot, and in trial 2, 40 weanlings. The first trial lasted from May 22, 1953, to August 14, 1953; the second, from June 6, 1953, to August 29, 1953; and the third, from June 25, 1953, to September 17, 1953.

The weanlings in lot 1 were given an all-mash ration with the following ingredients, all parts by weight:

Rice bran	40
Ground corn	20
Copra meal	20
Fish meal	20

In addition to this mixture, finely chopped green ipil-ipil (*Leucaena glauca* Linn.) was given three times a week. Ground shells and grit

[1] Central Experiment Station Contribution No. 1794. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, March, 1954. Prepared in the Department of Animal Husbandry under the direction of Instructor Amado C. Campos.

[2] Aurofac is a trade name for a vitamin B_{12}-antibiotic feed supplement (formerly called APF) commercially produced by the Lederle Laboratories of the American Cyanamid Company. It is guaranteed to contain not less than 1.8 grams of aureomycin and 1.8 milligrams of vitamin B_{12} to a pound. In addition, it contains not less than 10 per cent crude proteins, 1 per cent crude fat, and not more than 1 per cent crude fiber.

and fresh drinking water were left accessible to the birds at all times of the day. Lot II was given the same ration with 1 gram of Aurofac added to every 100 grams of the mash. The weanlings of the two lots were raised in separate but adjacent enclosures, each measuring 10 × 10 meters and provided with a grassy range and a rearing house. Except for the Aurofac supplementation in the ration of lot II, practically identical care and management was given to the weanlings of both lots.

The initial and weekly weights of the individual birds, amount and cost of feed consumed, rate of mortality, and other observations were recorded.

RESULTS AND DISCUSSION

Rate of growth. Lot II, the Aurofac-fed lot, was consistently heavier from the 13th week to the close of the experiment (table 1 and fig. 1). The total increase in weight of the birds in the Aurofac-fed lot was greater than that of the control lot. Likewise, the mean of the weekly increases in lot II was greater than that in lot I. These results clearly show the beneficial effect of Aurofac on the rate of growth of New Hampshire weanlings.

Amount and cost of feed consumed. The experimental birds consumed more feed than the control birds (table 2). This is attributed mainly to the greater number of birds in lot II in all the trials and partly to their heavier weights. When the amount of feed consumed to produce a kilogram gain was used as a measure of efficiency of feed utilization, lot II was also found to be more efficient than lot I.

Since poultry raisers are more interested in cost rather than in mere efficiency of feed utilization, the cost of feed to produce a kilogram gain in weight is a better criterion to use in the determination of the better ration. In this regard, lot II was still more profitable than lot I.

In spite of the additional expense of Aurofac, therefore, its inclusion in the College rearing ration justifies the added cost. This advantage will be greater if the Aurofac supplement is stopped after the 16th week.

Mortality. The superiority of Aurofac as a feed supplement for weanlings was again shown by the lower death rate of the weanlings in lot II in all the three trials (table 3). The difference in death rate between the two lots was 14.3 per cent, that is, there were 20 losses less in lot II.

Of the three trials, mortality was highest in trial 3 and lowest in trial 2 for both lots. The high mortality in both lots in trial 3 and in lot I in trial 1 was due mainly to the severe attacks of roup and fowl pox during these trials. Though lot II in trials 1 and 2

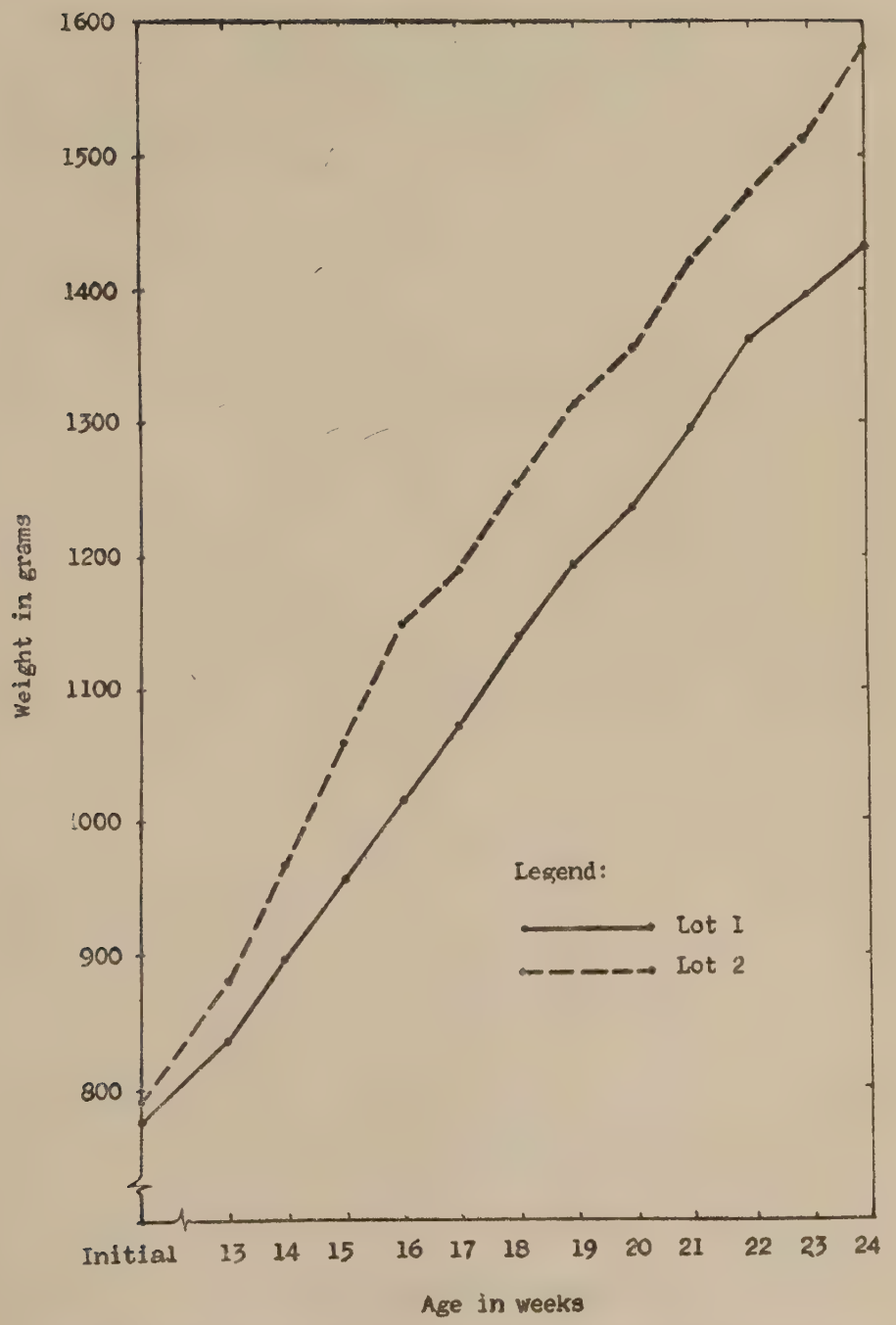

Fig. 1.—Average initial and weekly weights of the New Hampshire weanlings in the three trials.

and lot I in trial 2 were also attacked by roup, the severity of the infection was not enough to cause high mortality.

Other observations. Lot II birds were more vigorous and healthy, had brighter and smoother plumage, and exhibited deeper pigmentation than the control birds. The combs were also better developed in lot II, possibly indicating earlier sexual maturity.

TABLE 1

Average weekly weights in grams of New Hampshire weanlings in both lots

AGE IN WEEKS	LOT I				LOT II			
	Trial			Average	Trial			Average
	1	2	3		1	2	3	
Initial	781.2	835.8	696.9	771.3	814.2	833.8	698.8	782.3
13	816.0	931.0	747.0	831.3	898.2	932.3	798.4	876.3
14	946.4	951.3	804.2	900.6	976.6	1,004.3	909.8	963.4
15	970.9	1,071.9	827.2	956.7	1,093.8	1,118.8	944.3	1,052.3
16	1,034.9	1,130.0	875.9	1,013.6	1,162.0	1,237.0	1,031.5	1,143.5
17	1,107.4	1,163.3	934.9	1,068.5	1,227.8	1,241.4	1,099.0	1,189.4
18	1,143.3	1,250.8	1,017.0	1,137.0	1,322.5	1,290.8	1,163.3	1,258.9
19	1,227.7	1,291.7	1,055.4	1,191.6	1,340.9	1,363.8	1,219.1	1,307.9
20	1,235.7	1,327.5	1,085.3	1,216.2	1,345.0	1,435.0	1,269.5	1,349.9
21	1,277.8	1,426.8	1,192.9	1,299.2	1,373.6	1,506.0	1,377.0	1,419.9
22	1,352.5	1,478.8	1,248.6	1,360.0	1,439.8	1,530.8	1,429.1	1,466.6
23	1,422.8	1,480.6	1,291.4	1,398.3	1,498.0	1,555.9	1,478.4	1,510.8
24	1,464.7	1,489.7	1,335.7	1,430.0	1,574.0	1,604.6	1,563.2	1,580.6
	±24.11	±15.81	±35.84	±23.77	±18.96	±19.92	±29.07	±16.13

TABLE 2

Amount and cost of feed consumed

ITEM	LOT I				LOT II			
	Trial			Average	Trial			Average
	1	2	3		1	2	3	
Total amount of feed consumed, kilograms ..	214.0	207.6	212.8	211.5	238.0	214.5	236.7	229.7
Total cost of feed consumed, pesos [a]	74.20	62.27	63.84	66.77	77.11	69.50	76.69	74.43
Number of birds after 24 weeks	36	34	35	35	45	39	41	41.7
Total gain in weight from 12 to 24 weeks, kilograms	24.6	21.8	21.4	22.9	32.7	30.1	35.4	32.7
Amount of feed required to produce a kilogram gain, kilograms	8.7	9.5	9.9	9.4	7.3	7.1	6.7	7.0
Cost of feed required to produce a kilogram gain	2.58	2.80	2.97	2.78	2.37	2.30	2.17	2.28

[a] Cost of feed for lot I was ₱.30 and for lot II, ₱.324.

TABLE 3

Percentage of mortality

ITEM	LOT I				LOT II			
	Trial			Average	Trial			Average
	1	2	3		1	2	3	
Number of weanlings at the start	50	40	50	140	50	40	50	140
Number of birds after 24 weeks	36	34	35	105	45	39	41	125
Number of birds that died	14	6	15	35	5	1	9	15
Percentage of mortality	28.0	15.0	30.0	25.0	10.0	2.5	18.0	10.7

THE RURAL CREDIT SYSTEM IN NAGHALIN, KANANGGA, LEYTE [1]

MARIO V. MANULAT

Short-term loans were generally obtained by the farmers from private individuals and were usually spent on food. More than two-fifths of the loans had interest rates from zero to 99 per cent. Cash loans accounted for 82 per cent of the total number of loans, and commodity loans, 18 per cent. Only 4.9 per cent of the loans were secured with collateral. Fifty per cent of the farmers paid their debts at harvest. Loans were payable in commodity, in cash, in labor, or in two or more ways. The average cash loan given to farmers was ₱41.36. Merchants gave the biggest cash loans with interest lower than that charged by private individuals. The average commodity loan given by all lenders was ₱9.36. Landlords gave the biggest loans with the lowest interest rate.

Seventy-one per cent of the Naghalin farmers got store credit. Food and miscellaneous supplies were the most common items bought on credit. The debtors paid in cash, in kind, or in labor. Only 12 per cent of the farm operators had mortgages, whether on land, on jewelry, or on other property. Private individuals were the principal mortgagees. Forty per cent of the mortgagees resided in Naghalin. The interest rate ranged from zero to 84 per cent.

Forty-three per cent of the farmers knew where the nearest bank was located; 33 per cent did not; and 23 per cent were mistaken about the location. Nobody had ever heard of rural banks. Farmers who preferred banks as a source of credit gave low interest rate and ability to borrow any amount as their principal reasons. Those preferring landlords reported no security and ease in getting loans as their main reasons. Those who preferred merchants did so because the lender lived nearby or was a relative.

METHOD OF STUDY

The survey was conducted in the Naghalin area in the municipality of Kanangga, province of Leyte, from April to June, 1953. One hundred thirty-one farm operators and their wives were interviewed, and the data were summarized and analyzed by the tabulation method.

RESULTS AND DISCUSSION

Description of farm operators

Of the 131 farm operators, 85.3 per cent were tenants, 8.4 per cent were part-owners, and 5.3 per cent were full owners. The majority were men whose ages ranged from 18 to 90 years, or an average of 37 years. About forty-one per cent of the farm operators

[1] Central Experiment Station Contribution No. 1795. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agricultural Economics under the direction of Assistant Professor Nathaniel B. Tablante and Professor Lynn S. Robertson.

had had no formal schooling; 50 per cent had attended primary school; 7 per cent, intermediate school; and 2 per cent, high school. The average education of farm operators was 1.7 grades.

Most of the farm operators were born in the barrio where they were residing; however, most of the older farm operators were born in the province of Cebu.

On the average, the operators in the barrio had had a farming experience of 20.5 years. The average number of years they had worked on the farm where they lived at the time of the study was 7.2 years. There was a positive correlation between the number of years operators had farmed and the size of their farms.

Description of farms

Farm area and crops planted. The area of farms ranged from 0.5 hectare to 8 hectares. The average area operated by all farmers was 2.25 hectares.

An average of 1.8 hectares to a farm was planted to lowland rice. The total production was 37.8 cavans, or 21 cavans to a hectare. The operator's share averaged 20.5 cavans. The usual method of sharing in this area was on the 50-50 basis.

Corn was planted on an average area of 1 hectare to a farm, which had an average total production of 8.2 cavans. The operator's average share of corn was 4.6 cavans. Upland rice occupied 0.3 hectare of the total farm area; its average total yield was 3.7 cavans. The average share of the rice operator was 2 cavans. The low yield of crops was due to the typhoon that occurred in November, 1952.

The majority of the farmers raised a few vegetables, principally eggplant, sitao, gabi, and kamalungay. Most of the vegetables were consumed at home. Banana was the common fruit crop; jakfruit, caimito, avocado, and pineapple were also grown mostly for home consumption. The average value of all crops sold was ₱84.53.

Livestock raised. The average value of carabaos owned by the operator constituted about seventy-three per cent of the average total value of livestock (table 1). The other carabaos constituted 11 per cent of the total value of livestock. Swine and poultry constituted 16 per cent.

Farm and nonfarm labor. Farm work was distributed among the operator and the members of his family (table 2). Selling was a common occupation among the women. The farmer's family began nonfarm work after the planting season.

Assets. Estimates of farm assets of the farm operators were based on the values of April, May, and June, 1953 (table 3).

Short-term credit

Purpose. About forty-six per cent of the total number of loans taken by farmers were for food (table 4) because farmers did not have enough means of subsistence to last them from one harvest to another. Mabbun [2] stated that there is a tendency for borrowers to use their credit for consumption purposes.

[2] Pablo N. Mabbun, *Philippine Agriculturist*, 25, 493 (1936).

Most of the loans for medical treatment were bigger than those for other purposes. The most common disease of the farmers who borrowed money for medical treatment was tuberculosis.

Source. Private individuals were the principal source of credit of Naghalin farmers. They constituted about forty-seven per cent of the total number of lenders. Relatives constituted 28 per cent; landlords, 15 per cent; and businessmen, 10 per cent. Most of the farmers borrowed from two or more sources.

Residence of lenders. Fifty-one per cent of the lenders resided in the Naghalin area; 27 per cent lived in near-by barrios and municipalities; and 22 per cent, in places far from Naghalin.

Months when credit was used. Most of the farmers obtained their loans in January, February, March, and April (table 5). The loans taken during these months were primarily for food. In June, July, and December they were primarily for the preparation of the field. In June part of the loans was used for paying matriculation fees and buying school supplies. During the other months, the farmers borrowed for emergencies. The heaviest borrowing was in February because it was during this month that the adverse effect of the typhoon was felt.

Interest rates. The annual interest rates ranged from zero to 624 per cent. More than two-fifths of the loans had interest rates from zero to 99 per cent (table 6). The interest rate on one out of 10 loans was more than 200 per cent. Mabbun [3] reported that farmers in Aparri paid as high as 200 per cent interest on loans.

Types of loan. Cash loans accounted for 82 per cent of the total number of loans (table 7). The common practice among farmers was to pay one cavan of palay after harvest for every five pesos in cash borrowed. Most of the commodity loans were for consumption purposes.

Security offered. The loans were secured with promissory notes, crop liens, land titles, or, in a large majority of cases, without any collateral (table 7).

Time and method of payment. Fifty per cent of the borrowers paid their debts at harvest time (table 7) because many of the loans were paid in crops. Loans with no fixed date of payment were usually payable on demand. The loans were payable in commodity, in cash, in labor, or in two or more ways.

Sale of crops to lenders. Only 2 per cent of the borrowers were required to sell their crops to the lender (table 7). Sometimes, when the creditors were buyers, the farmers sold their crops to them at regular prices.

Relation of type of lender to credit practices. Merchants gave the highest average cash loans with an interest rate lower than that charged by private individuals (table 8). The reason for this was

[3] *Ibid.*

that the farmers who borrowed from merchants were usually either relatives or close friends of the merchants. Relatives other than merchants lent the next biggest cash loans and charged the lowest interest. There was only a slight difference between the average loans given by private individuals and those given by landlords, but the private individuals charged higher interest than the landlords. Other lenders gave the smallest cash loans with the highest interest.

Landlords gave the highest average commodity loans with the lowest interest rate (table 8). Most of the landlords did not charge interest from their tenants especially when the loans were paid immediately after harvest. Private individuals gave the next biggest commodity loans with an average interest rate higher than that charged by the landlords. Relatives gave the third biggest commodity loans with an interest rate between that charged by landlords and that charged by private individuals. Merchants and other sources gave the smallest commodity loans but charged the highest rate of interest.

Payment experience. No significant variation existed among the lenders in percentage of loans wholly paid, partially paid, and not paid at the end of the year (table 9).

Store credit

The Naghalin farmers obtained store credit (table 10) largely as a supplement to other loans. Food and miscellaneous supplies were the most common items bought on credit. Miscellaneous supplies included salt, laundry soap, matches, and kerosene. School supplies, farm supplies, and clothing were not commonly purchased on account. Most of the store credit was obtained from Filipino stores as Chinese stores were found only in municipalities outside the area.

The majority of the farmers who borrowed from stores did not follow any definite schedule of payment because of the irregularity of their earnings. The store debtors paid in cash, in kind, and in labor. Some of the debtors sold their crops to the store even when they were not obliged to do so.

Mortgages

Only 12 per cent of the farm operators had mortgages. Sixty-three per cent of the mortgages were on land, 25 per cent on jewelry, and 12 per cent on other property.

Mortgagees. Private individuals were the primary mortgagees, constituting 53 per cent of the total. Relatives constituted 27 per cent, and businessmen, 13 per cent. Other persons comprised the remainder.

Forty per cent of the mortgagees resided in Naghalin, 33 per cent in Ormoc City, and 27 per cent in other places.

Relation of size of farm to amount of mortgage. There was a consistent relation between size of farm and amount of mortgage, although farms of over 4 hectares had mortgages more than three times as big as those on farms smaller than 1.5 hectares (table 11).

Years when mortgages were obtained. Forty per cent of the mortgages were obtained in 1952, 7 per cent as early as 1948, 13 per cent in 1950, 7 per cent in 1951, and 33 per cent in 1953.

Purpose of mortgages. The aggregate amount of mortgages on all farms was ₱3711 (table 12). Included under miscellaneous purposes were the buying of land and plows and the payment of taxes and priority rights to work on a given piece of land.

Period of mortgages. Two-fifths of the mortgage loans were made for a period of three to six years (table 13). Most of the loans which had no fixed terms were payable on demand.

Interest rate. The interest rate on mortgages ranged from zero to 84 per cent (table 14). Loans whose interest rates depended upon the borrowers were those obtained from relatives.

Farmers' attitude to credit

Farmers' knowledge of the nearest agencies. Forty-four per cent of the farm operators knew that the nearest bank was in Ormoc City (table 15). Thirty-three per cent admitted that they did not know where the nearest bank was, and 23 per cent were mistaken in the location. Some mentioned Kanangga as the nearest municipality with a commercial bank, but this town actually has none. Apparently the farmers thought that a postal savings bank also engages in loaning transactions.

Reasons for preferring various sources of credit. Farmers who preferred banks as sources of credit gave low interest rate and ability to borrow any amount as their principal reasons (table 16). Story [4] reported that Vermont dairymen who preferred the land bank gave the low interest rates and long terms as their principal reasons.

Farm operators preferring landlords as sources of credit reported no security and ease in getting loans as their main reasons. Other reasons were that they were working on the landlord's land, that the landlord knew and trusted them, and that the landlord was within easy reach.

Farm operators preferring merchants did so mainly because the lender lived near-by or was a relative. Other reasons given were ease in obtaining loans, acquaintance between the lender and the borrower, and ability to pay in crops.

[4] Robert P. Story, *Vermont Agric. Exper. Sta. Bull.*, 571 (1953).

TABLE 1

Kind, number, and value of livestock owned by operators of 131 Naghalin farms, 1953

KIND OF STOCK	AVERAGE NUMBER ON A FARM	AVERAGE VALUE ON A FARM
Work animal	0.8	₱138.17
Other carabao	0.2	20.23
Pig	1.4	10.68
Sow	0.4	9.33
Barrow	0.1	1.49
Hen	2.6	3.87
Pullet	0.7	0.80
Rooster	1.0	2.72
Young chicken	6.2	1.75
Others	0.2	1.08
All livestock		₱190.12

TABLE 2

Farm and nonfarm labor of 131 Naghalin farmers, 1953

FAMILY MEMBER	AVERAGE AGE IN YEARS	AVERAGE NO. OF MONTHS WORKED ON FARM	PERCENTAGE OF ALL PERSONS ENGAGED IN VARIOUS KINDS OF WORK					AVERAGE NET NON-FARM INCOME IN PESOS
			Farm labor	Carpentry	Selling	Others	None	
Operator	37.4	4.7	64.9	6.9	—	13.7	14.5	138.99
Wife	32.2	2.5	20.0	—	19.1	6.1	54.8	57.04
Sons	15.0	3.1	38.6	—	—	1.4	60.0	72.10
Daughters	15.1	2.0	20.7	—	2.4	12.2	64.7	41.78
Other members	27.2	3.2	23.1	—	—	3.8	73.1	59.85
Other sources	—	—	—	—	—	—	—	46.50

TABLE 3

Operators' total assets and assets of each farm

TYPE OF ASSET	TOTAL ASSETS	AVERAGE TO A FARM	PERCENTAGE OF TOTAL
Cash on hand	₱ 1,004.30	₱ 7.67	0.5
Accounts receivable	6,735.70	51.41	3.4
Supplies on hand	4,263.45	32.54	2.1
Investment in commercial enterprise	72.00	0.55	[a]
Total liquid assets	₱ 12,075.45	₱ 92.17	
Household goods	6,910.00	52.74	3.5
Farm tools	6,323.25	48.27	3.2
Farm buildings	15,255.00	116.44	7.6
Livestock	24,907.80	190.12	12.4
Horse	540.00	4.12	0.3
Others	2,049.00	15.64	1.0
Total working assets	₱ 55,985.05	₱ 427.33	
Farm land	29,360.00	224.11	14.6
Other farm land	101,600.00	775.51	50.7
Nonfarm land	30.00	0.23	[a]
Nonfarm buildings	1,429.00	10.91	0.7
Total fixed assets	₱132,410.00	₱1,010.76	

[a] Less than 0.05 per cent.

TABLE 4

Purpose of short-term loans of 131 Naghalin farmers, 1953

PURPOSE	PER CENT
Food	46.2
Preparation of the field	20.6
Medical treatment	6.4
Marriage	6.4
Land	3.5
Burial expenses	3.5
Matriculation fees	2.1
Clothes	2.1
Home building	1.4
Business	1.4
Legal fees	1.4
Others	5.0

TABLE 5

Months when short-term loans were given to 131 Naghalin farmers, 1953

MONTH	PER CENT
January	14
February	22
March	11
April	8
May	7
June	11
July	9
August	3
September	3
October	3
November	4
December	5

TABLE 6

Number and percentage of short-term loans with various interest rates of 131 Naghalin farmers, 1953

INTEREST RATE IN PER CENT	NUMBER OF LOANS	PERCENTAGE OF LOANS
None	71	26.6
Depending on borrower	1	0.4
11–49	44	15.5
50–99	52	19.5
100–149	53	19.8
150–199	21	7.9
200 & over	25	9.3

TABLE 7

Type, security, and payment arrangements for short-term loans to 131 Naghalin farmers, 1953

ITEM	PER CENT
Type:	
Cash loans	82
Commodity loans	18
Security:	
Promissory note	4.1
Crop lien	0.4
Land	0.4
No security	95.1
Time of payment:	
At harvest	50
On fixed calendar date	2
No fixed date	48
Method of payment:	
In cash	41
In commodity	57
In labor	1
In two or more ways	1
Sale of crops to lender:	
Debtor required to sell	2
Debtor not required to sell	98

TABLE 8

Type of lender, amount of short-term loans, and interest charged 131 Naghalin farmers, 1953

LENDER	CASH LOANS		COMMODITY LOANS	
	Amount of loan	Annual interest rate	Value of loan	Annual interest rate
	pesos		*pesos*	
Private individual	38.79	115.7	8.76	78.10
Relative	42.53	50.6	7.98	40.40
Landlord	33.45	104.5	14.11	10.21
Merchant	62.70	76.0	5.00	332.80
Others	3.00	240.0	6.50	321.50
Average (weighted)	41.36	95.2	9.36	72.2

TABLE 9

Number and percentage of short-term loans wholly, partially, and not paid by 131 Naghalin farmers at the end of 1953

LENDER	WHOLLY PAID		PARTIALLY PAID		NOT PAID	
	number	*per cent*	*number*	*per cent*	*number*	*per cent*
Private individual	71	54	5	4	55	42
Relative	32	49	4	6	29	45
Landlord	20	51	4	10	15	39
Merchants	13	46	2	7	13	46
Others	2	50	0	0	2	50

TABLE 10

Use of store credit by 131 Naghalin farmers, 1953

ITEM	NUMBER OR PER CENT
Percentage of farmers using store credit	71
Average number of stores to a farmer	1.2
Farmers buying various items on credit:	
Food	73
School supplies	10
Farm supplies	3
Clothes	2
Miscellaneous	68
Farmers who used store credit in various months:	
Two or more months	3
Throughout the year	90
Percentage of stores extending credit:	
Chinese	6
Filipino	94
Period of payment:	
Weekly, per cent	34
Irregular, per cent	66
Type of payment:	
In cash, per cent	82
In commodity, per cent	14
In labor, per cent	4
Percentage of farmer-debtors required to sell to store	12
Average unpaid store debt at end of year in pesos	3

TABLE 11

Size of farm and amount of mortgage of 131 Naghalin farmers, 1953

SIZE OF FARM	AMOUNT OF MORTGAGE
hectare	*pesos*
0.5–1.4	400.00
1.5–2.0	1,105.00
2.2–3.0	726.00
4.0–8.0	1,480.00

TABLE 12

Purpose of mortgages obtained by 131 Naghalin farmers, 1953

PURPOSE	AMOUNT OF MORTGAGE	PERCENTAGE OF TOTAL
Medical treatment	₱1,675.00	45
Building of house	800.00	22
Food	270.00	7
Payment of debts	254.00	7
Miscellaneous ...	712.00	19

TABLE 13

Term of mortgages obtained by 131 Naghalin farmers, 1953

TERM IN YEARS	NUMBER OF LOANS	PERCENTAGE OF LOANS
1–2	1	7
3–4	4	27
5–6	2	13
7–8	1	7
No fixed term	7	46

TABLE 14

Variation in interest rates on mortgages of 131 Naghalin farmers, 1953

INTEREST RATE IN PER CENT	PERCENTAGE
1–9	7
10–19	13
20–29	13
30–39	13
40 or over	13
Depending upon borrower	27
None	14

TABLE 15

Knowledge of credit agencies by 131 Naghalin farmers, 1953

ITEM	PERCENTAGE OF FARMERS
Had heard of ACCFA	3
Had heard of rural banks	0
Knew that Ormoc City Bank was nearest bank	44
Place farmers thought nearest bank located:	
Kanangga	11
Tacloban City	9
Cebu City	4
Did not know	33

TABLE 16

Reasons given by 131 Naghalin farmers for preferring various sources of credit, 1953

REASON	BANKS	LANDLORD	MERCHANT
	per cent	*per cent*	*per cent*
Small interest rate	54		
Ability to borrow any amount	15		
Ease in obtaining loan		22	12
Acquaintance between lender and borrower		7	12
Nearness of lender		6	19
Ease in paying in crops		3	12
No security		16	
Farmer working on landlord's land		11	
Trust of lender in borrower		9	
Borrower not forced to pay at once		4	
Borrower not ashamed to borrow from lender		4	
Borrower can ask for extension		4	
Lender does not confiscate right away		3	
Lender a relative			13
Other reasons	31	11	32

THE USE OF MACHINERY IN THE PRODUCTION OF SUGAR CANE[1]

ROMEO A. OBORDO

Thorough cultivation and effective control of weeds in the cane field were possible with a mechanical cultivator. The last hilling-up, however, was done with animal-drawn plows because the plants were too tall by that time. The crop yielded 59.84 tons of cane or 81.82 piculs of sugar to a hectare in spite of a poor stand of only 67.21 per cent. The cost of production was high mainly because not all of the phases of sugar cane culture were mechanized. With ₱6.32 as the cost of producing a picul of sugar and ₱15.05 as the market price, the cane culture realized a profit of ₱8.73 a picul and a net profit of ₱714.29 to a hectare.

The poor yield of sugar cane has often been attributed to poor cultural methods. Gordon[2] stated that the labor requirement necessary for sugar cane growing affects more than one-half the cost of production. Catambay[3] found that corn plants in the mechanized fields were taller, more vigorous, and subsequently produced bigger yields than those in the fields tilled with animal-drawn implements.

This study was conducted in the Departments of Agricultural Engineering, Agronomy, and Agricultural Chemistry, UP College of Agriculture and Central Experiment Station, from November, 1952, to February, 1954, to determine (1) the labor requirement and cost of mechanized production of sugar cane, (2) the performance of the various machines used in each operation, and (3) the profit or loss from the mechanized culture of the crop.

MATERIALS AND METHODS

Plowing. The field used in this study was 1 hectare of fairly level clay loam soil previously planted to rice. It was plowed twice with a four 32-inch disc plow drawn by a D-4, Caterpillar, crawler type of tractor. Because of inclement weather the soil was hard to plow and it changed in physical condition from time to time.

Harrowing. Immediately after each plowing, harrowing was done with a J.D. Killefer 184-A 24-24-inch disc harrow pulled by an I.H. T-D-9 crawler type of tractor.

Furrowing. Furrows were laid about 1.2 meters apart with a three-row cane furrower mounted on an -MD tractor. The uniform

---

[1] Central Experiment Station Contribution No. 1796. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1954. Prepared in the Departments of Agricultural Engineering and Agronomy under the direction of Professor Alejandro B. Catambay and Associate Professor Valeriano C. Calma.

[2] A. Gordon, *Agric. Engin. Jour.*, 1, 39 (1950).

[3] A. B. Catambay, *Agric. Engin. Jour.*, 1, 17 (1950).

distances between furrows were possible because the furrower was fixed firmly on the tractor.

Preparing the seed pieces. Seed pieces of College 39 sugar cane cut 30 to 35 centimeters long and having three or more nodes each were soaked in running water for 48 hours and incubated for 24 hours. They were hauled to the field in a ¾-ton wagon hitched to a Ford Ferguson tractor.

Planting and replanting. The hills were distanced 0.5 of a meter apart in the furrow. Only one seed piece was planted to a hill. The germinating cane points encountered dry weather so that almost one-half of them died. Replanting was done six weeks later immediately after a heavy rain. Because of the poor germination of the seed pieces, the experimental area was decreased to only 4390 square meters or 0.439 of a hectare. The plants in the discarded area were used as replanting materials in the missing hills.

Cultivation and weeding. Three weeks after replanting, a cultivator with nine sweep blades was passed over the rows twice. A week later, off-barring cultivation was done with an I.H. two-row cane cultivator mounted on the -MD tractor. The weeds at the base of the plants were weeded out with a hoe. Hilling-up was done after fertilization. The final hilling-up was done with animal-drawn plows because the plants were too tall to permit mechanized cultivation.

Fertilization. Ammonium sulfate fertilizer with 21.5 per cent nitrogen was applied on the third month of growth at the rate of 200 kilograms to a hectare or approximately twelve grams to a hill. The moist condition of the fertilizer did not permit mechanical application so that the plants were fertilized by hand.

Harvesting, weighing, analysis, and milling. The canes were topped on February 2, 1954, and harvested on February 7, 1954. Just before harvesting, the percentage of stand of the crop was determined. Millable stalks of 25 stools taken at random from the field were cut and weighed. A representative stalk of each of the 25 stools was crushed in a hand mill, and the mixed juice was analyzed for apparent purity and sucrose content.[4] The harvested canes were hauled to the College Station and delivered in N.B. cars to the Canlubang sugar mill on February 9, 1954, for weighing, milling, and analysis of the juice.

RESULTS AND DISCUSSION

Percentages of germination and stand of plants in the field. Because of the adverse weather at the time of planting, the cane points gave only 46.42 per cent germination. Most of the seed pieces which had been soaked and incubated were beginning to germinate at the time of planting; hence, they suffered badly from insufficient moisture in the soil. The percentage of germination was determined by counting the missing hills and the hills with plants.

[4] The analyses were made by Assistant Professor Leopoldo Villanueva of the Department of Agricultural Chemistry.

The missing hills in about one-half of the field were replanted so that the field was reduced to an area of only 0.439 hectare. At the time of harvesting, the crop had a field stand of 67.21 per cent.

Habit of growth. When the plants were about two months old they were erect, but strong winds in September and October caused the majority of the stools to lodge.

Pests and diseases. No serious pests and diseases were observed. Rats, probably from near-by sugarcane fields, attacked the lodging plants, but the damage they caused was not serious. An early stage of sugarcane mosaic (*Marmor sacchari* Holmes),[5] which was observed during the first cultivation, did not affect the plants seriously.

Flowering and maturing of the crop. The plants started to flower in late October. Ten months after planting or by the end of November, most of the plants had already flowered. Cajigal[6] observed flowering seven months after planting.

With a Bausch and Lomb hand refractometer, the maturity of the cane plants was determined weekly from the time the plants were 10 months old till they were harvested. A representative stalk was examined of each of 10 stools taken at random. The plants were considered mature when the refractometer readings from the basal, middle, and terminal portions of the stalks were more or less the same. By February 5, 1954, or at the age of 12 months, the plants were considered mature. The same length of time was reported by Calma and Ramos[7] in their study of the same variety.

Percentages of apparent purity and sucrose of juice. As analyzed in the Department of Agricultural Chemistry, College 39 had an apparent purity of 86.48 per cent and a sucrose content of 13.77 per cent. In the analysis made in Canlubang, however, the percentage of apparent purity was 83.25 and the percentage of sucrose in cane was 13.07. The discrepancy was due to the fact that the juice analyzed in the Department of Agricultural Chemistry came from newly cut, fresh cane stalks, whereas those analyzed in Canlubang came from canes which had been topped five days and harvested two days before they were milled. This apparently was the cause of the very low yield of sugar from each ton of cane (table 1). According to Calma,[8] the loss of sugar was 1.8 per cent when the topped cane was allowed to stand in the field for one day, and the loss amounted to 16.4 per cent after 13 days. The apparent purity of the cane in this study was less than that observed by Cajigal.[9]

---

[5] Identified by Dr. Faustino T. Orillo of the Department of Plant Pathology.

[6] Jose B. Cajigal, "A Comparative Study of Sugar Cane Varieties, College 39 and POJ 2878." (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, October, 1952. Unpublished.)

[7] Valeriano C. Calma and Federico V. Ramos, *Philippine Agriculturist*, **33**, 190 (1950).

[8] Valeriano C. Calma, *Philippine Agriculturist*, **24**, 283 (1935).

[9] *Ibid.*

Labor requirement. Table 1 shows the labor requirement and cost of raising 1 hectare of the crop with machinery.

Yield. The actual and computed yields of cane and sugar to a hectare and of sugar to a ton of cane are shown in table 2. It should be noted that computed yields of cane and sugar were based upon a crop with a percentage stand of only 67.21. It should also be recalled that the canes had very low sucrose undoubtedly because of the deterioration of the canes as a result of delayed milling. A higher percentage of stand at the time of harvesting would of course give a better yield.

Cost of production. The cost of production included laborers' wages, charges for the use of machinery and equipment, cost of supplies and seed pieces, and land rent (table 3).

In computing the charges for the use of the equipment, the formula by Catambay [10] was used (table 4).

Income from the crop. Based on the average selling price of sugar of ₱15.05 a picul and the average cost of producing a picul of sugar, which was ₱6.32, a profit of ₱8.73 a picul was realized (table 2). The profit from 1 hectare of the crop was ₱714.29.

[10] Catambay, *op. cit.*

TABLE 1

Labor requirement and cost of raising 1 hectare of the crop

OPERATION	NUMBER OF HOURS	LABOR COST [a]
		pesos
Plowing:		
1st	3.64	2.05
2nd	3.64	2.05
Harrowing:		
1st	1.36	0.77
2nd	1.36	0.77
Furrowing	1.09	0.61
Planting [b]	48.00	24.00
Replanting [c]	16.94	8.47
Cultivation:		
1st	1.02	0.57
2nd	2.20	1.23
3rd	2.20	1.23
4th [d]	36.40	33.20
Weeding [e]	72.80	36.40
Fertilization [f]	18.20	9.10
Harvesting and loading [g]		227.39
Total		347.84

[a] The tractor driver received ₱4.50 for one 8-hour day. All other laborers received ₱4.00.

[b] Six men required for the operation.

[c] One man required for the operation.

[d] Two men required for the operation. The animal was hired for ₱15.00 a hectare cultivation.

[e] Four men required for the operation.

[f] Four men required for the operation.

[g] Men hired under contract basis. They were paid ₱3.80 a ton.

TABLE 2

Actual yield of cane,[a] juice analyses, and computed yields of cane, sugar to a ton cane, and sugar to a hectare

VARIETY	ACTUAL WEIGHT OF MILLED CANES	CRUSHED JUICE ANALYSIS			COMPUTED YIELD OF CANE TO A TON CANE	YIELD OF SUGAR TO A TON CANE	COMPUTED YIELD OF SUGAR TO A HECTARE
		Corrected brix	Polarization	Apparent purity			
	tons	*degree*	*per cent*	*per cent*	*tons*	*piculs*	*piculs*
College 39	26.47	15.7	13.07	83.25	59.84	1.36	81.82

[a] Yield based upon 67.21 per cent stand only.

TABLE 3

Cost of production and income of a hectare of the crop

Labor cost	₱347.84
Land rent[a]	70.00
Charges for the use of machinery and implements	37.49
Seeds[b]	9.99
Fertilizer, $(NH_4)_2SO_4$,[c] 21%N	30.22
Fuel and lubricants for tractors and implements[d]	6.04
Interest on average working capital	14.92
Cost of producing a hectare of crop, pesos	516.72
Yield a hectare, tons	59.84
Cost of producing a ton of cane, pesos	8.64
Yield a hectare, piculs[d]	81.82
Cost of producing a picul, pesos	6.32
Market price of sugar a picul, pesos	15.05
Profit a picul, pesos	8.73
Profit a hectare, pesos[e]	419.83

[a] Land rent at ₱70.00 a hectare a year.
[b] Seed pieces at ₱6.00 for every 10,000 points.
[c] Fertilizer at ₱6.80 for a 45-kilogram bag.
[d] Planter's share is 60 per cent of the profit.
[e] Gasoline at ₱0.2125 a liter; diesel fuel at ₱0.105; crank case oil at ₱0.62 a liter; gear oil at ₱0.61 a liter; grease at ₱0.01 an hour.

TABLE 4

Charges for the use of machinery and implements [a]

KIND OF IMPLEMENT	COST	MAXIMUM NUMBER OF DAYS USED A YEAR	ESTIMATED LIFE IN YEARS	HOURS USED	DEPRECIATION	INTEREST	HOUSING AND REPAIRS
	pesos				*pesos*	*pesos*	*pesos*
Tractor:							
D-4	18,574	140	12	7.28	9.75	4.09	3.62
TD-9	9,610	140	12	2.72	1.88	0.79	0.70
Farmall-MD	7,711	140	8	6.51	5.45	1.54	1.34
Ford Ferguson	3,405	140	8	0.65	0.23	0.06	0.06
Four 32-inch disc plow	4,218	100	14	7.28	2.65	1.30	1.15
24–24-inch disc harrow	2,071	100	14	2.72	0.48	0.23	0.21
Two-row cane cultivator	2,014	100	15	5.42	0.88	0.46	0.41
Furrower	1,000	90	15	1.09	0.09	0.05	0.04
Wagon	350	100	10	0.35	0.01	0.01	0.01
Total					21.42	8.53	7.54

Grand total 37.49

[a] Formula by Catambay was used.

THE DIGESTIBILITY OF TROPICAL KUDZU (PUERARIA JAVANICA) AND POÑGAPONG (AMORPHOPHALUS CAMPANULATUS) BY SWINE [1]

J. K. Loosli,[2] Valente Villegas, and L. A. Ynalvez [3]

The carbohydrates of poñgapong were found to be highly digestible. Cooked poñgapong contained 0.7 per cent digestible protein and 14.8 per cent total digestible nutrients when fed in a balanced ration. Tropical kudzu contained 1.4 per cent digestible protein and 14.8 per cent total digestible nutrients.

Poñgapong roots (*Amorphophalus campanulatus* [Roxb.] Blm.) are frequently fed to swine,[4] but no data have been published as to their probable feeding value.[5] Tropical kudzu (*Pueraria javanica* Benth.) thrives in many parts of the Philippines. The broad leaves and tender vines of this legume are readily eaten by swine. It has a high protein content which would make it a desirable pasture forage. Because of their potential value the two feeds were studied as supplements to a standard concentrate mixture for weanling pigs.

EXPERIMENTAL METHODS

Digestion experiments were carried out with six weanling pigs. The pigs were kept in individual pens constructed to permit quantitative collection of the feces and accurate recording of the feeds eaten. The poñgapong was cooked before feeding. The feeds were given to the pigs once a day, and adequate water was provided them. Following a five-day preliminary period of constant feed intakes, fecal collections were made for seven days. Of each day's feces 25 per cent was dried under sun lamps and preserved for analysis. Parts of the tropical kudzu vines that were not eaten (orts) were also analyzed.

RESULTS AND DISCUSSION

The chemical composition of the feeds and the uneaten parts of the tropical kudzu is shown in table 1. The orts contained somewhat more fiber but less protein than the parts that were eaten, suggesting that the pigs ate more leaves then stems.

The digestion coefficients are presented in table 2. In the first series of trials poñgapong was fed to the animals along with a

---

[1] Central Experiment Station Contribution No. 1797.

[2] Visiting professor of animal husbandry from Cornell University.

[3] The authors acknowledge the assistance of A. Palacpac and S. E. Claud in caring for the animals and of Lolita Austria and Epifania Cruz in making the chemical analyses.

[4] V. Villegas, *Nat. Res. Council Bull.*, 35, (1953).

[5] B. H. Schneider, "Feeds of the World," West Virginia Agric. Exper. Sta., Morgantown, West Virginia, 1947.

concentrate mixture. In the second series poñgapong was given as the only feed along with water, salt, and shells. Digestion coefficients for the poñgapong were calculated by difference by correcting for the influence of the concentrates. Coefficients determined in a separate trial in which the concentrates were fed alone were used.

The coefficients by the two methods showed fair agreement, except that those for protein and fat were much lower when poñgapong was fed alone. These results agree with previous experiments in which such digestibility coefficients were depressed by the presence in the fecal excretions of relatively larger proportions of metabolic fecal nitrogen and fat when feeds low in these constituents were fed to the animals.

The digestion coefficients were larger for the ration containing tropical kudzu and concentrates than for tropical kudzu alone as calculated by difference. This is expected because the forage is high in fiber. That the protein and N.F.E. of the tropical kudzu were relatively well utilized by the young pigs shows that this leguminous forage is a useful feed even for weanling pigs. It is likely that sows and boars can make better use of tropical kudzu than weanling pigs.

Both poñgapong and tropical kudzu are relatively low in nutrients (table 3) because of their high water content in the form they are fed. Cooked, dried poñgapong would be a highly digestible starchy feed for swine, containing as it does more than 80 per cent of T.D.N. (dry basis), but it is too low in protein, minerals, and vitamins to be a complete food. When properly supplemented it would make a very useful feed. Tropical kudzu is fairly high in protein. It is a good source of carotene and contains 0.90 per cent calcium and 0.26 per cent phosphorus. The high calcium content will help correct the calcium deficiency of rice bran and copra meal. Feeding trials should be made to determine the proportion of tropical kudzu which can be fed with good results to swine of various ages.

TABLE 1

Composition of the feeds in per cent

FEED	MOISTURE	PROTEIN	FAT	FIBER	N.F.E.	ASH
Concentrate mixture	12.6	13.2	11.6	6.8	47.2	8.6
Poñgapong (raw) ..	71.5	1.7	0.6	0.9	24.1	1.2
Poñgapong (cooked)	83.4	1.1	0.2	1.1	13.1	1.1
" "	83.7	1.4	0.2	0.8	13.0	0.9
Tropical kudzu	81.7	2.8	1.1	7.0	5.6	1.8
Tropical kudzu, orts	82.0	1.9	0.6	8.9	5.3	1.3

TABLE 2

Digestion coefficients for poñgapong and tropical kudzu

FEED	ANIMAL NO.	ORGANIC MATTER	PROTEIN	FAT	FIBER	N.F.E.
		per cent	*per cent*	*per cent*	*per cent*	*per cent*
Poñgapong and concentrates	1526	86.8	75.4	87.0	53.1	92.5
	1527	83.3	65.3	83.7	50.2	90.1
	1541	91.2	76.1	91.2	77.0	95.3
Mean	—	87.1	72.3	87.3	60.1	92.6
Poñgapong (by difference)	1526	92.9	71.8	68.4	56.9	98.3
	1527	84.9	38.2	94.7	48.0	93.9
	1541	102.9	76.5	157.9	128.4	103.8
Mean	—	93.6	62.2	107.0	77.8	98.7
Poñgapong (fed alone)	3	89.0	43.4	63.5	76.2	94.7
	1815	84.1	5.7	32.2	68.7	92.6
	1874	84.7	27.1	57.4	60.6	92.8
Mean	—	85.9	25.4	51.0	68.5	93.4
Tropical kudzu and concentrates	1526	79.1	68.7	82.2	58.4	89.0
	1527	77.8	68.7	80.6	56.6	85.2
	1541	75.3	65.2	84.5	52.4	82.7
	3	70.8	70.8	72.3	29.2	80.0
	1815	74.6	74.0	76.5	41.0	82.3
	1874	69.5	74.4	66.1	18.8	79.2
Mean	—	74.5	70.3	77.0	42.7	83.1
Tropical kudzu (by difference)	1526	71.3	45.4	49.2	91.6	103.0
	1527	65.7	46.2	37.3	60.1	81.0
	1541	55.2	32.4	63.8	53.2	65.6
	3	12.1	51.1	−35.0	−11.3	25.2
	1815	38.2	64.8	−13.3	23.4	51.3
	1874	—5.1	64.5	−55.6	−35.4	10.0
Mean	—	39.6	50.7	7.7	30.3	56.0

TABLE 3

The digestible protein and total digestible nutrient content of the feeds

FEED	DIGESTIBLE PROTEIN	TOTAL DIGESTIBLE NUTRIENTS	NO. OF TRIALS
	per cent	*per cent*	
Poñgapong, cooked:			
fed alone	0.3	13.4	3
by difference	0.7	14.8	3
Tropical kudzu:			
by difference	1.4	6.9	6

EFFECTS OF VARYING AMOUNTS OF AMMONIUM PHOSPHATE FERTILIZER ON KENAF [1]

RAUL R. SOLIDUM

Fertilization rates of 100, 200, and 300 kilograms to a hectare produced significant increases in yield of kenaf fiber over the control. The 300-kilogram application gave the heaviest mean yield and the highest tensile strength of fiber. An increase in the amount of fertilizer was followed by a corresponding increase in the height of the plants; however, only the 200- and 300-kilogram rates produced significantly taller plants than the control.

A knowledge of the effects on kenaf (*Hibiscus cannabinus* Linn.) of varying amounts of ammonium phosphate (16 per cent N) is important since kenaf in our country is increasingly being used in lieu of jute. According to Haarer,[2] fiber tends to coarsen when the yield is high, and kenaf, like other Hibiscus fibers, is a little too coarse and is not as flexible as jute. To determine the effects of different rates of fertilizer (16-16-0) upon the yield and quality of kenaf fiber under certain field conditions, this study was conducted from May, 1953, to February, 1954, in the field and laboratory of the Division of Fiber and Oil Crops, College of Agriculture and Central Experiment Station, Los Baños, Laguna.

MATERIALS AND METHODS

Preparing the land. A fairly well-drained field of Lipa clay loam previously planted to jute was thoroughly plowed and harrowed. The soil had a pH of 5.8 and had .05 per cent nitrogen, 17 ppm. phosphorus, 61 ppm. potassium, 1320 ppm. calcium, and 1040 ppm. magnesium.[3] Twenty plots, each 3 meters long and 1.5 meters wide, were prepared at random. One-meter paths between blocks and 30-centimeter spaces between plots were provided.

Planting and fertilizing. Kenaf seeds of varieties *viridis* and *vulgaris* taken from Soriano and Company, Manila, were planted on May 19, 1953, at distances of 8 inches between rows and 2 inches between plants. A week later ammonium phosphate fertilizer was applied at rates of 35, 70, and 105 grams to a plot, equivalent to 100, 200, and 300 kilograms to a hectare. Each treatment had five replications.

Thinning, weeding, and cultivation. When the plants were 15 centimeters high, the distances between them were reduced to 2 inches. Weeding was begun three weeks after planting and was

[1] Central Experiment Station Contribution No. 1798. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1954. Prepared in the Department of Agronomy under the direction of Associate Professor Pedro A. David.

[2] A. E. Haarer, *Econ. Bot.*, 6, 18 (1952).

[3] Data were obtained from the department of Soils.

done once a week thereafter. The whole area was cultivated once on June 20, 1953, partly with a trowel and partly with a native cultivator.

Harvesting and retting. On September 17, 1953, the plants began to flower. They were harvested at the age of 141 days when almost all the plants were in full bloom. Ten plants were cut at random from each plot, measured, and weighed. The bark ribbons were separated from the woody portion. They were then soaked in water, which was changed every 12 hours.

After 11 days of retting, the fibers were washed to remove the pulp. To determine the percentage of extraction, the bundles were air-dried to a constant weight and weighed separately.

Determining the tensile strength. A Scott Tester IP-2 tensilgraph machine was used to determine the breaking load of 10 samples of single-fiber strands taken from each treatment and the control. The tensile strength was then computed according to the formula recommended by Botkin, Shires, and Smith.[4]

DISCUSSION OF RESULTS

Growth of plants. During the early part of growth, the treated and the untreated plants did not differ conspicuously in vegetative growth. Two weeks after fertilization, however, the plants differed slightly in color and height; fertilized plants were greener and taller than the unfertilized ones. As the plants grew older, the differences became more marked.

Control of pests and diseases. Generally, untreated plants were more susceptible to pests and diseases than the fertilized ones. Their leaves were yellowish and some of them were stunted. The plants had to be sprayed on July 12, 1953, for they showed signs of kenaf blight caused by *Phoma sabdariffae* Sacc.[5] The fungicide used was Spraycop 53 at a proportion of 18.18 grams of basic copper fungicide to a gallon of water.

The pests were more destructive than kenaf blight. *Sylepta derrogata* Fabr.[6] infested the leaves of the plants and was controlled with Gesarol E-25, an emulsifiable DDT,[7] at a proportion of 1½ tablespoons to a gallon of water. *Anomis erosa* Hübner [8] was also found attacking the young plants.

[4] C. W. Botkin, C. B. Shires, and E. C. Smith, *New Mexico Agric. Exper. Sta. Bull.*, 300 (1943).

[5] Dr. Faustino T. Orillo of the Department of Plant Pathology identified the disease and recommended the spray.

[6] Identified by Dr. Silverio M. Cendana of the Department of Entomology.

[7] The insecticide was recommended by Dr. Getulio B. Viado of the Department of Entomology.

[8] The insect was identified by Dr. Silverio M. Cendaña of the Department of Entomology.

Yield of dry fiber. Table 1 shows the amount of dry fiber in grams of 10 harvested plants from each plot. The 300-kilogram application gave the heaviest yield of 138.08 grams. Treatment differences were found to be highly significant.

Height of plants. An increase in the amount of fertilizer was followed by a corresponding increase in the height of the plants (table 2). The plants were tallest in the 300-kilogram treatment and shortest in the untreated plots. The control and the 100-kilogram treatment, however, were not significantly different. In the 200-kilogram treatment, a slight increase in height was observed.

Tensile strength of fiber. The fibers from the 300-kilogram treatment had the highest tensile strength, and those from the plots without fertilizers had the lowest (table 3). The 100-kilogram treatment did not differ much from the 200-kilogram rate, and the single-fiber strands from the 200-kilogram treatment were not significantly higher in tensile strength than those from the control plots.

Percentage extraction of fiber. There was no rise in percentage of extraction of fiber with an increase in the fertilizer applied (table 4). This can be explained by the fact that fertilization increases the weight of the whole plant and not only of certain parts. While the bark ribbons increased in weight because of the fertilizer applied, the woody portion also correspondingly increased. Thus the percentage of extraction of fiber was almost the same in the fertilized and the control plants. Regression analysis would have given the same results.

TABLE 1

Yield of dry fiber in grams of 10 plants from each plot

BLOCK	CONTROL	100 KG./HA.	200 KG./HA.	300 KG./HA.	TOTAL
1	68.5	103.8	110.0	138.0	420.3
2	71.6	86.7	106.3	130.4	395.0
3	89.0	89.8	103.0	131.0	412.8
4	94.0	84.5	110.5	136.0	425.0
5	81.0	102.3	105.9	155.0	444.2
Total	404.1	467.1	535.7	690.4	2097.3
Mean	80.82	93.42	107.14	138.08	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	VARIANCE	COMPUTED F-VALUE	TABULAR F-VALUE 5%	TABULAR F-VALUE 1%
Blocks	4	321.53	80.38			
Treatments	3	9,087.81	3,029.27	39.56	3.49	5.95
B × T	12	918.93	76.58			
Total	19	10,328.27				

L.S.M.D. = 12.00

TABLE 2

Average height in meters of 10 kenaf plants from each plot

BLOCK	CONTROL	100 KG./HA.	200 KG./HA.	300 KG./HA.	TOTAL
1	2.226	2.366	2.233	2.244	9.069
2	2.269	2.378	2.541	2.978	10.166
3	2.187	2.229	2.394	2.599	9.409
4	2.132	2.434	2.629	2.615	9.810
5	2.099	2.312	2.337	2.674	9.422
Total	10.913	11.719	12.134	13.110	47.876
Mean	2.183	2.344	2.427	2.622	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	VARIANCE	COMPUTED F-VALUE	TABULAR F-VALUE 5%	TABULAR F-VALUE 1%
Blocks	4	.177	.0443			
Treatments	3	.501	.1670	8.39	3.49	5.95
B × T	12	.239	.0199			
Total	19	.917				

L.S.M.D. = 0.194

TABLE 3

Tensile strength in kilometers of two fiber strands taken from each plot

BLOCK	CONTROL		100 KG./HA.		200 KG./HA.		300 KG./HA.		TOTAL
1	16.14	18.00	12.88	11.87	16.50	21.60	39.00	46.10	182.09
2	20.10	14.30	17.06	17.85	19.37	17.10	40.55	39.50	185.83
3	15.37	12.25	21.57	22.40	17.50	25.70	30.66	45.70	191.15
4	9.16	10.00	11.25	18.70	16.00	15.17	32.19	36.33	148.80
5	14.30	17.00	21.00	17.00	19.25	16.87	36.50	42.19	184.11
Total	75.07	71.55	83.76	87.82	88.62	96.44	178.90	209.82	891.98
Mean	14.66		17.15		18.51		38.87		

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE 5%	TABULAR F-VALUE 1%
Blocks	4	142.52	35.63	857.44		
Treatments	3	3,842.66	1,280.89		3.49	5.95
B × T	12	52.26	4.36			
Sampling error	32		332.60	10.39		
	20	280.34	14.02			
Total	39	4,317.78				

L.S.M.D. = 4.13

TABLE 4

Average percentage extraction of fibers from 10 plants

BLOCK	CONTROL	100 KG./HA.	200 KG./HA.	300 KG./HA.
1	5.84	5.25	7.89	7.57
2	4.25	6.33	6.13	4.13
3	7.44	8.57	5.53	7.31
4	10.94	5.02	8.40	7.06
5	7.82	10.34	6.38	6.81
Total	36.29	35.51	34.33	32.88
Mean	7.26	7.10	6.87	6.58

INCREMENT IN BODY TEMPERATURE AND RESPIRATION OF PHILIPPINE STEERS AFTER PLOWING [1]

VALENTE VILLEGAS AND CRISPULO Q. QUIRIN [2]

A study was conducted to determine the increment in body temperature and respiration of Philippine steers after plowing two hours and four hours in the morning and in the afternoon. The work was undertaken in the Department of Animal Husbandry from December, 1948, to November, 1949.

MATERIALS AND METHODS

Six steers of the Batangas strain of Philippine cattle were used. The smallest, Makisig (Herd No. 3), weighed 387 kilograms and measured 122 centimeters from the withers to the ground; the largest, Bilukao (Herd No. 6), weighed 519 kilograms and had a height of 133 centimeters from the withers. The average weight of all the steers was 459.2 kilograms and the average height, 129 centimeters. The average age was 9.5 years, the range being from 7 to 13 years. All the steers were medium in condition.

A level field of clay loam with an average moisture content of 29.98 per cent was used in the investigation. It was plowed with a native plow with a cut 10.16 centimeters in width. The work was usually started at 7 o'clock in the morning and at about one o'clock in the afternoon. Only one plowman was employed throughout to minimize error due to personal equation.

Immediately before and after each plowing, the body temperature and respiration of the animal were taken. The body temperature was taken with a veterinary thermometer kept in the rectum for three minutes. The rate of respiration was determined by placing the palm of the hand over one nostril of the animal. Forty-five readings were made before and after the two-hour plowing in the morning and 41 readings before and after the four-hour plowing. In the afternoon, 43 readings were made before and after the two-hour plowing and 45 readings before and after the four-hour plowing.

DISCUSSION OF RESULTS

After the two-hour plowing in the morning. After the two-hour plowing in the morning the increase in body temperature ranged from 1.7 $\pm$ 0.35°C. to 2.4 $\pm$ 0.23°C. (table 1). The *t* values were significant for all the steers.

The increase in respiration ranged from 59.3 $\pm$ 5.4 to 80.8 $\pm$ 5.02 times a minute. The *t* values for all the animals were significant.

[1] Central Experiment Station Contribution No. 1799. Read before the Los Baños Biological Club on February 26, 1954.

[2] At present Junior Fertilizer Supervisor of San Fernando, La Union.

After the four-hour plowing in the morning. The increase in temperature after the four-hour plowing in the morning fluctuated from 2.1 ± 0.30°C. to 3.1 ± 0.19°C. (table 2). The *t* values show that for all the steers the difference was significant.

The increase in respiration was from 65.1 ± 9.2 to 93.1 ± 1.69 times a minute. Based on the *t* values, the differences were highly significant.

After the two-hour plowing in the afternoon. The rise in body temperature after two hours' plowing in the afternoon was significant, as shown by the *t* values (table 3). The minimum difference was 1.7 ± 0.29°C. and the maximum was 2.3 ± 0.16°C.

The increase in respiratory rate after plowing ranged from 54.8 ± 4.98 to 81.8 ± 3.00 times a minute. Subjected to the *t* test, the difference was highly significant.

After the four-hour plowing in the afternoon. The increment in body temperature after four hours' work in the afternoon was highly significant (table 4). The minimum difference was 1.6 ± 0.24°C. and the maximum was 2.4 ± 0.16°C.

The difference in respiration was also highly significant. The minimum was 54.4 ± 4.86 and the maximum was 82.1 ± 3.19 times a minute.

CONCLUSION

After plowing for two and four hours in the morning and in the afternoon, Philippine steers showed highly significant increases in body temperature and respiration, especially in respiration. According to Dukes,[3] factors other than chemical stimulus are responsible for the increase in respiratory rate, or hyperpnea, arising from muscular exertion. Such factors include receptors in the joints, adrenaline, pH changes, rise in venous pressure and body temperature, and motor discharges from the higher brain centers.

[3] H. H. Dukes, "The Physiology of Domestic Animals," Comstock Publishing Co., Inc., Ithaca, New York, 1947, 817 pp.

TABLE 1

Body temperature and respiration of Philippine steers before and after plowing for two hours in the morning

STEER	NO. OF OBSERVATIONS	BODY TEMPERATURE				RESPIRATION					
		Before plowing	After plowing	Difference	*t* value	Before plowing	After plowing	Difference	*t* value	Tabular *t* value 5%	Tabular *t* value 1%
		°C.	°C.	°C.							
Steady, H. No. 2	8	38.5	40.9	2.4±0.23	10.435	24.8	101.0	76.2±3.61	21.108	2.365	3.499
Makisig, H. No. 3	8	38.5	40.3	1.8±0.23	7.826	25.2	93.5	68.3±3.3	20.327	2.365	3.499
Bilukao, H. No. 6	8	38.4	40.8	2.4±0.20	12.000	23.9	104.7	80.8±5.02	16.096	2.365	3.499
Kalejon, H. No. 9	5	38.4	40.2	1.8±0.24	7.500	24.7	84.1	59.3±5.4	10,982	2.776	4.604
Kamal, H. No. 10	9	38.5	40.2	1.7±0.35	4.857	26.2	86.6	60.4±6.46	9.350	2.306	3.355
Kalo, H. No. 11	7	38.5	40.4	1.9±0.33	5.758	25.6	94.0	68.4±5.17	13.230	2.447	3.707

TABLE 2

Body temperature and respiration of Philippine steers before and after plowing for four hours in the morning

STEER	NO. OF OBSERVATIONS	BODY TEMPERATURE				RESPIRATION					
		Before plowing	After plowing	Difference	*t* value	Before plowing	After plowing	Difference	*t* value	Tabular *t* value 5%	Tabular *t* value 1%
		°C.	°C.	°C.							
Steady, H. No. 2	6	38.3	40.6	2.3±0.22	10.4545	23.8	105.2	81.4±4.73	17.209	2.571	4.032
Makisig, H. No. 3	6	38.4	40.6	2.2±0.15	14.6666	24.8	106.1	81.3±2.7	30.111	2.571	4.032
Bilukao, H. No. 6	6	38.3	41.4	3.1±0.19	16.3157	21.6	114.7	93.1±1.69	55.089	2.571	4.032
Kalejon, H. No. 9	10	38.3	40.5	2.2±0.44	5.000	22.0	87.1	65.1±9.2	7.068	2.262	3.250
Kamal, H. No. 10	5	38.4	40.6	2.2±0.46	4.7826	22.5	101.5	79.0±7.18	11.003	2.776	4.604
Kalo, H. No. 11	8	38.3	40.4	2.1±0.30	7.000	22.6	87.8	65.2±6.34	10.284	2.365	3.499

TABLE 3

Body temperature and respiration of Philippine steers before and after plowing for two hours in the afternoon

STEER	NO. OF OBSERVATIONS	BODY TEMPERATURE				RESPIRATION					
		Before plowing	After plowing	Difference	*t* value	Before plowing	After plowing	Difference	*t* value	Tabular *t* value 5%	Tabular *t* value 1%
		°C.	°C.	°C.							
Steady, H. No. 2	6	38.7	40.7	2.0±0.08	25.000	27.7	106.2	78.4±2.95	26.576	2.571	4.032
Makisig, H. No. 3	7	38.7	40.5	1.8±0.18	10.000	28.8	98.1	69.3±3.98	17.412	2.447	3.707
Bilukao, H. No. 6	6	38.7	41.0	2.3±0.16	14.375	26.3	108.1	81.8±3.00	27.267	2.571	4.032
Kalejon, H. No. 9	10	38.6	40.2	1.6±0.25	6.400	27.30	82.10	54.8±4.98	11.004	2.262	3.250
Kamal, H. No. 10	6	38.7	40.6	1.9±0.32	5.9375	25.6	100.3	74.7±7.26	10.289	2.571	4.032
Kalo, H. No. 11	8	38.7	40.4	1.7±0.29	5.862	26.2	84.1	57.9±5.45	10.624	2.365	3.499

TABLE 4

Body temperature and respiration of Philippine steers before and after plowing for four hours in the afternoon

STEER	NO. OF OBSERVATIONS	BODY TEMPERATURE				RESPIRATION					
		Before plowing	After plowing	Difference	*t* value	Before plowing	After plowing	Difference	*t* value	Tabular *t* value 5%	Tabular *t* value 1%
		°C.	°C.	°C.							
Steady, H. No. 2	9	38.8	40.9	2.1 ±0.21	10.000	27.4	101.5	74.1 ±3.75	19.7600	2.306	3.355
Makisig, H. No. 3	8	38.7	40.6	1.9 ±0.20	9.500	27.9	99.8	71.9 ±3.84	18.724	2.365	3.499
Bilukao, H. No. 6	8	38.7	41.1	2.4 ±0.16	15.000	27.1	109.2	82.1 ±3.19	25.737	2.365	3.499
Kalejon, H. No. 9	5	38.63	40.62	1.99±0.25	7.960	26.40	96.05	69.65±5.24	13.292	2.776	4.604
Kamal, H. No. 10	8	38.6	40.2	1.6 ±0.24	6.667	27.7	82.1	54.4 ±4.86	11.193	2.365	3.499
Kalo, H. No. 11	7	38.7	40.6	1.9 ±0.55	3.4545	28.4	98.5	70.1 ±5.20	13.481	2.447	3.707

FERTILIZER TESTS ON CORN [1]

VALERIANO C. CALMA AND PEDRO B. ESCURO

A series of studies was conducted in the College of Agriculture on the application of fertilizers to corn. Different brands of commercial fertilizers were applied to the corn plants when they were about ten to fifteen centimeters tall. The area around the plants was scratched and the fertilizers were placed there at the rates of 50, 75, 100, and 150 kilograms to a hectare. The results of the studies are summarized in table 1.

The best rate of application regardless of the brand or N-P-K content of the fertilizer was 100 to 150 kilograms to a hectare. The increase in yield due to the application of the fertilizers ranged from 12.47 to 93.33 per cent, and the gain ranged from ₱0.85 to ₱39.24 to a hectare.

A separate study covering one wet-season and one dry-season crop was conducted from May, 1952, to March, 1953, to determine the effects of the different fertilizer combinations and rates of application upon the germination, growth, and yield of corn. The effect of lime upon the germination, growth, and yield of corn was likewise studied.

Four kinds of fertilizers were used, namely, ammonium sulfate (21-0-0), ammonium phosphate (16-16-0), superphosphate (0-20-0), and muriate of potash (0-0-58).[2]

A relatively uniform upland field of clay loam soil was prepared in the usual manner. Twenty-four plots, each 5 x 14 meters and replicated four times, were laid out following the randomized block design. Five furrows, one meter apart, were laid in each plot.

Just before planting, lime was broadcast uniformly in the assigned plots at the rate of 2 tons to a hectare. The land was then harrowed. Twenty-three different rates of application and N-P-K combinations were prepared. Twenty-two of these combinations were distributed evenly along the furrows in their respective plots just before planting at the rate of 350 kilograms of the basic fertilizer mixture to a hectare.

In the wet-season culture, seeds of College Yellow Flint were planted from June 6 to 9, 1952, and in the dry-season culture, from December 2 to 3, 1952. Three seeds were planted in each hill at the rate of 25,000 hills to a hectare in 23 treatments and at the rate of 18,000 hills to a hectare in one treatment.

---

[1] Central Experiment Station Contribution No. 1800. Paper read at the 8th Pacific Science Congress, November 27, 1953.

[2] The fertilizers were supplied by Mr. Cayetano Pineda of the Fertilizer Administration, Manila.

One and a half to two weeks after planting, the germinated plants in each treatment were counted and the percentages of germination were computed. The plants were thinned to one plant to a hill and the missing hills were replanted. Weeding was performed whenever necessary. The plants of the plots which required side dressing were side-dressed with ammonium sulfate and other fertilizers at the specified rates when they were one month old or when they had attained a height of about fifty or sixty centimeters. Then the plants were hilled-up or closed-in with a native plow.

In both cultures, the relative growth, color, vigor, susceptibility to pests and diseases, lodging, flowering, and maturity of the plants as influenced by the different treatments were observed weekly from germination to harvesting. Likewise, the stand of the plants in the field was determined just before harvest.

The ears were harvested as soon as most of them had dried husks. In the wet-season planting, the plants in each border row and those within a meter from the ends of each plot were discarded. In the dry-season culture, however, all of the ears in each plot were husked and shelled. The kernels were dried and then weighed to determine the percentage of shelling.

In the wet-season culture, the various treatments failed to effect any appreciable difference in growth and in yield of grains of the plants because of the leaching of the fertilizers from one plot to another. Successive rains after planting resulted in overflooding of the field. Although no conclusive result was obtained from this experiment, it was noted that germination was impaired in the plots to which the nitrogenous fertilizers had been applied in concentrated form before the planting of the seeds.

In the dry-season planting, all the treatments resulted in greater vegetative vigor of the plants. Vigor of growth seemed to be directly related to the proportion of nitrogen in the fertilizer combination and the rate of application, regardless of the kind of fertilizer applied. Lime was beneficial both to the growth of plants and to the yield of grain.

With the exception of those two plots which had not been given ammonium sulfate as a side dressing, the different plots gave significantly higher yields than the control (table 2). It will be further noted that the proportion of nitrogen in the fertilizer, rather than either phosphorus or potassium, was responsible for the increase in the yield of corn. The application of 2 tons of lime to a hectare gave the highest yield even though only the minimum amount of nitrogen in the fertilizer combination was used. This result suggests that using lime, rather than increasing the amount of nitrogenous fertilizer, will be more profitable since lime is very much cheaper than nitrogenous fertilizer.

TABLE 1

Results of several years of fertilizer tests on corn in the College of Agriculture

CULTURE	BRAND AND COMPOSITION OF FERTILIZER	BEST RATE OF APPLICATION TO A HECTARE [a]	YIELD OF CONTROL	INCREASE IN YIELD TO A HECTARE FROM FERTILIZER		VALUE OF INCREASE IN YIELD TO A HECTARE	TOTAL COST OF FERTILIZER AND APPLICATION	GAIN TO A HECTARE FROM FERTILIZER [b]
		kg.	*cavans*	*cavans*	*per cent*	*pesos*	*pesos*	*pesos*
Dry season	Arado Extra	150	18.87	15.24	80.76	49.53	26.85	22.68
Wet season	14–6–2	150	29.68	11.90	40.10	38.67	26.85	11.82
Dry season	Non–Plus–Ultra	75	24.14	9.98	41.34	31.44	10.43	21.01
Wet season	16.5–20–0	50	32.48	4.05	12.47	13.16	6.95	6.21
Dry season	Corona Arroz	100	12.59	4.83	38.36	13.28	11.56	1.72
Wet season	9–9–4	150	15.40	12.36	80.26	33.99	15.32	18.67
Dry season	Bat guano 6.84–14.78–1.17	150	29.89	5.06	16.93	16.44	12.66	3.78
Dry season	Nitrophoska IG No. 2	100	13.80	10.54	76.38	31.62	24.95	6.67
Wet season	14–11.7–26	100	16.63	15.52	93.33	46.56	24.95	21.61
Dry season	Mayon No. 2	75	17.17	6.95	40.48	24.33	13.91	10.42
Wet season	13–13–8	100	31.36	16.18	51.59	56.63	17.39	39.24
Dry season	Hoz	150	13.79	8.69	63.02	30.42	20.50	9.92
Wet season	13–6–2	150	35.78	16.47	46.03	57.65	24.18	33.47
Dry season	Superphosphate	100	23.67	6.96	29.40	24.36	11.83	12.53
Wet season	0–(18–20)–0	100	13.47	8.54	63.40	29.89	10.91	18.98
Dry season	Ammonium phosphate	100	12.12	8.57	70.71	27.85	16.33	11.52
Wet season	20–20–0	100	15.55	9.41	60.51	30.58	16.83	13.75
Dry season	Leunaphos	100	25.78	11.11	43.10	30.55	15.61	14.94
Wet season	20–20–0	100	20.44	12.07	59.05	32.19	15.61	16.58
Dry season	Corona No. 1	150	15.82	7.52	47.53	27.22	23.24	3.98
Wet season	10–6–2	150	25.10	6.93	27.61	24.25	23.40	0.85
Dry season	Ammonium sulfate	150	17.48	12.38	70.82	29.71	15.75	13.96

Average yield—20.96

[a] The rates of application of fertilizer were 50, 75, 100, and 150 kg. to a hectare.

[b] The gain was computed by multiplying the increase in yield by the current price of one cavan of corn and subtracting the cost of fertilizer and its application from the value of the increase in yield.

TABLE 2

Mean yield of grains in kilograms

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
Control	11.6	9.6	11.4	2.0	34.6	8.65
0–12–12 + side dress	15.8	12.8	13.0	9.8	51.4	12.85
6–12–12 + side dress	15.2	13.6	13.4	12.4	54.6	13.65
12–12–12 + side dress	15.8	16.8	15.4	13.4	61.4	15.35
18–12–12 + side dress	19.0	14.0	16.2	16.8	66.0	16.50
24–12–12 + side dress	20.2	16.0	15.4	16.4	68.0	17.00
12– 0–12 + side dress	18.4	16.2	15.0	15.0	64.6	16.15
12– 6–12 + side dress	15.2	15.8	14.6	12.6	58.2	14.55
12–18–12 + side dress	14.2	16.6	16.6	7.0	54.4	13.60
12–24–12 + side dress	17.2	17.6	14.2	11.4	60.4	15.10
12–12– 0 + side dress	17.6	14.0	14.2	15.4	61.2	15.30
12–12– 6 + side dress	16.0	16.6	14.8	10.0	57.4	14.35
12–12–18 + side dress	18.2	14.4	11.8	13.2	57.6	14.40
12–12 24 + side dress	16.0	16.0	14.0	10.2	56.2	14.05
12–12–12 + side dress + lime	19.8	17.4	16.0	15.8	69.0	17.25
12–12 12 + no side dress	12.2	13.4	9.8	7.6	43.0	10.75
12–12–12 applied as side dress	12.8	11.8	11.6	6.6	42.8	10.70
12–12–12 half rate + side dress	13.8	13.4	13.4	10.2	50.8	12.70
12–12–12 double rate + side dress	18.2	15.6	16.0	16.0	65.8	16.45
12–12–12 + 100 kg. to a hectare side dress	15.8	17.2	14.6	14.4	62.0	15.50
12–12–12 + 200 kg. to a hectare side dress	18.6	18.8	16.2	10.0	63.6	15.90
12–12–12 + 300 kg. to a hectare side dress	16.8	14.8	14.8	13.2	59.6	14.90
12–12–12 + 400 kg. to a hectare side dress	19.6	17.4	16.2	15.2	68.4	17.10
12–12–12 + side dress with 18,000 plants to a hectare	15.6	11.6	13.0	11.4	51.6	12.90 [a]
Total	378.0	349.8	328.6	274.6	1,331.0	332.75
Mean	16.42	15.21	14.29	11.94	57.87	14.47

[a] Excluded from analysis of variance and, hence, from replication totals.

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					.05	.01
Blocks	3	249.43	83.14	29.378		
Treatments	22	425.49	19.34	6.834	1.71	2.13
B × T	66	186.62	2.83			
Total	91	861.54				

Significant Mean Difference:
At .05 = 2.37
At .01 = 3.16

METHODS OF PROCESSING VANILLA PODS [1]

PILAR C. TOLIBAS

The scratch method gave more vanillin than either the hot-water or the oven-wilt method. There was no marked difference in moldiness among the pods cured by the three methods. The color and texture of the cured vanilla pods were fairly good, but the aroma was a prunelike fermented one. In general, pods cured by the hot-water method were of fairly good quality and had less splitting, but they contained less vanillin crystals.

The Philippine annual importation of cured vanilla pods and extracts shows the present large demand for these products and the high prices paid for them.[2] The drying and curing of vanilla pods require much care. A practical method of artificial curing which can produce vanilla pods with high vanillin content, good aroma and texture, and less moldiness and splitting is desirable.

Arana [3] observed that in some localities sun heat was not sufficient for drying vanilla pods. An artificial drier maintained at a temperature of 45° to 50°C. (113-122°F.) was necessary. Scratching as a curing treatment of the pods seemed better than other methods because it required a shorter time for drying and resulted in a high vanillin content and less splitting. The hot-water treatment was also found satisfactory; it produced very few moldy beans and less splitting. Oven-wilting required a shorter time for drying and sweating, produced less split pods, and gave a higher vanillin content.

To find out which of the three methods is best suited to local conditions and which produces good-quality cured pods, this study was conducted in the Departments of Agronomy and Agricultural Chemistry from December, 1952, to March, 1954.

MATERIALS AND METHODS

A total of 2234 pods was harvested from four-year-old vanilla plants (fig. 1, upper panel). Harvesting was started in December, 1952, when the tips of the pods were already yellow. The pods were classified according to length and then wiped with a moist clean cloth. The overmature split pods were separated from the normally matured pods before they were cured. The normally matured pods were weighed. Five replications of each method of curing were made. The vanillin content was analyzed twice.

---

[1] Central Experiment Station Contribution No. 1801. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1954. Prepared in the Department of Agronomy under the direction of Associate Professor Pedro A. David and Mr. Antonio V. Valida.

[2] P. A. David, *Philippine Agriculturist*, 33, 239 (1950).

[3] Francisco E. Arana, *Fed. Exper. Sta. Bull.*, 25 (1945).

Fig. 1. Upper panel—four-year-old vanilla plants in full bearing. Middle panel—air-drying of partially cured pods after sweating overnight. Lower panel—scratch method of curing vanilla pods: (a) two pins stuck in the soft wood; (b) scratching did not extend to the tips of the pods. The surface was stained to show the wounds. (*Photographed by Dr. Julian Banzon of the Photographic Division.*)

Scratch method. Two pins were stuck into a piece of soft wood 1 millimeter apart, with a protrusion of from 1 to 1½ millimeters (fig. 1, lower panel). The wounds were scratched longitudinally on the pods but not until the tips.

The pods were heated in the electric oven at a temperature of 45° to 50°C. The following formula by Kevorkian, Jones, and Arana, cited by Arana,[4] to determine the moisture level which produces good-quality pods was used:

$$100 - y = \frac{100 - x}{100 - z}$$

where

y = weight in pounds of fresh pods after curing
x = percentage of moisture in fresh pods (80 per cent)
z = percentage of moisture in cured pods (30–34 per cent).

Heating and drying were done alternately until the 31 per cent moisture level was reached. During the partial curing, the pods were passed through the fingers for even oil distribution.[5] After a day's heating, the partially dried pods were wrapped in rectangular pieces of woolen blankets (3 × 1½ ft.) and kept in air-tight containers for sweating. The following morning the pods were air-dried (fig. 1, middle panel). The excess moisture was wiped off and molds on some of the pods were removed. The storage or aging of the partially cured pods ranged from three to six months (fig. 2, upper panel).

The extract was prepared by the maceration method suggested by Jacobs.[6] Thirty grams of finely chopped cured vanilla pods were soaked in 300 cc. of a mixture of 95 per cent ethyl alcohol and an equal volume of distilled water. This vanilla solution was kept in sterilized glass jars for four months; then the supernatant liquid was analyzed in the Department of Agricultural Chemistry.

Hot-water method. This method is similar to the scratch method except for the killing treatment. Instead of being scratched, the pods were tied together, placed in a medium-sized rattan basket, and dipped in hot water with a temperature of 51°C. (114°F.). They were dipped twice within fifteen seconds, each dipping lasting from five to seven seconds. Then they were transferred to screen racks (7 × 4 ft.) for draining.

Oven-wilt method. The vanilla pods were placed in the electric oven at 60°C. for 16.6 hours. The heating (45° to 50°C.) and sweating process was the same throughout.

---

[4] *Ibid.*

[5] H. N. Ridley, "Spices," London, 1912, 499 pp.

[6] M. B. Jacobs, "The Chemistry and Technology of Feed and Food Products," Interscience Publishers Inc., New York, 1944.

Fig. 2. Upper panel—representative samples of pods cured by the three methods showing vanilla crystals on the surface. Note glass jars for aging. Lower panel—vanillin crystals as seen under a microscope. (47×). (*Photographed by Dr. Julian Banzon of the Photographic Division.*)

RESULTS AND DISCUSSION

Length of vanilla pods. The mean length in centimeters of the fresh vanilla pods was 13.74 ∓ .056, and the coefficient of variability was 19.3 per cent.

Number of hours of heating. The length of oven-heating was significantly different in the hot-water and in the oven-wilt method (table 1). This marked difference was due to the fact that in the oven-wilt method the fresh vanilla pods were treated under high temperature at the start of the drying process, whereas in the hot-water method the temperature of the killing treatment was so low that more hours of oven exposure were required in curing. The hours of exposure to heat of the fresh pods in the oven-wilt method reached an average of 16.6 instead of the 24 hours suggested by Arana.[7] The difference in average number of hours of oven-heating either between the scratch and the oven-wilt method or between the scratch and the hot-water method was insignificant.

Degree of splitting. The number of split pods was markedly high in the scratch method (table 2), probably because of the surface wounds on the pericarp of the pods. The difference in the average splitting of the pods cured by the hot-water and the oven-wilt method was slight.

Vanillin content. The scratch method gave more vanillin[8] in terms of milligrams to 100 cc. of vanilla solution. There was a significant difference of 22.0 milligrams between the scratch and oven-wilt methods (table 3). The difference between the hot-water and the oven-wilt method was 5.2 milligrams. Usually the pods were covered with white needle-shaped crystals of vanillin, the presence of which is considered by some to be a criterion of quality (fig. 2, lower panel).

Color, texture, and aroma. The color of the pods cured by the three methods varied only slightly from blackish brown to aniline black.[9] The cured pods were pliant. The prunelike fermented aroma was almost the same in the three methods. There was no discernible improvement in aroma even when the cured pods were aged longer.

Degree of moldiness. Moldiness in the three methods was almost the same. The common mold (*Aspergillus oryzae*)[10] was found mostly during the first and second weeks of curing usually on the basal end of the pods. Thorough cleaning, wiping off of the excess moisture, and separation of the affected pods at once lessened moldiness. A 95 per cent ethyl alcohol was also used for cleaning moldy pods.

---

[7] Arana, *op. cit.*

[8] The author wishes to express her gratitude to Dr. Julian Banzon of the Department of Agricultural Chemistry for analyzing the vanillin content of the solutions.

[9] Based on R. Ridgeway's "Color Standards and Color Nomenclature," A. Hoen and Co., Baltimore, Maryland, 1912.

[10] Identified by Mrs. V. M. Ela of the Department of Plant Pathology.

TABLE 1

Hours of oven exposure at 45–50°C. in each method

METHOD	REPLICATION					TOTAL	MEAN
	1	2	3	4	5		
Scratch	18	22	19	19	16	94	18.8
Hot-water	23	19	21	21	19	103	20.6
Oven-wilt	17	18	18	14	16	83	16.6
Total	58	59	58	54	51	280	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Replication	4	15.34	3.83	1.19	3.84	7.01
Treatment	2	40.14	20.07	6.21	4.46	8.65
Error	8	25.86	3.23			
Total	14	81.34				

L.S.M.D. = 2.63

TABLE 2

Average number of split pods in each method based on five replications

METHOD	TOTAL NUMBER OF PODS	TOTAL SPLIT PODS	AVERAGE
Scratch	270	27	10.0
Hot-water	329	11	3.34
Oven-wilt	432	16	3.93
Total	1,031		

TABLE 3

Amount of vanillin crystals in milligrams for every 100 cc. vanilla solution

METHOD	REPLICATION		TOTAL	AVERAGE
	I	II		
Scratch	98.4	97.6	196.0	98.0
Hot-water	75.2	76.8	152.0	76.0
Oven-wilt	71.2	70.4	141.6	70.8
Total			489.6	

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Treatment	2	833.92	416.96	651.50	9.55	30.82
Error	3	1.92	.64			
Total	5	835.84				

L.S.M.D. = 2.55

TABLE 4

Color of the cured vanilla pods

REPLICATION	SCRATCH METHOD	HOT-WATER METHOD	OVEN-WILT METHOD
1	Aniline black	Aniline black	Aniline black
2	Blackish brown	Blackish brown	Aniline black
3	Aniline black	Aniline black	Blackish brown
4	Aniline black	Aniline black	Aniline black
5	Aniline black	Blackish brown	Aniline black

BIOCHEMICAL STUDIES ON ABACÁ MOSAIC VIRUS AND BUNCHY-TOP OF ABACÁ VIRUS: I. EFFECT OF VIRUS INFECTION ON CATALASE ACTIVITY OF THE HOST [1]

APOLINARIO R. CARANGAL, JR. AND ELVIRA B. MANZANILLA [2]

The catalase activity of mosaic-infected abacá seedlings was lower than that of healthy plants. In seedlings affected with bunchy-top the results were varied.

The role of catalase in respiration is probably to remove from the tissues hydrogen peroxide produced in other respiratory reactions which might accumulate to toxic levels. Studies by Yamafuji and Fujuki,[3] Yoshihara,[4] and Yamafuji and Cho [5] on tobacco and silkworm seemed to suggest that hydrogen peroxide stimulated the denaturation and then the polymerization of nucleoproteins, thus provoking the formation and propagation of virus protein. The object of this investigation was to determine whether or not the findings of the Japanese workers could be applied to a comparison of the catalase activity of healthy plants and of plants infected with the viruses of abacá mosaic and bunchy-top of abacá.

Catalase activity can be measured by determining the amount of hydrogen peroxide remaining after the action of catalase for a definite length of time. The residual peroxide may be titrated with potassium permanganate, or the liberated iodine from potassium iodide may be titrated with sodium thiosulfate. An alternative method is measuring manometrically the volume of oxygen produced.

EXPERIMENTAL PROCEDURE

The catalase activity was determined by a modified procedure based on the method described by the A.O.A.C.

Three- to five-gram samples of the fresh diseased leaves were sliced and comminuted with water and 0.5 gram $CaCO_3$ in the Waring Blender for 5 minutes. The washings and the blended samples were filtered through nonadsorbent cotton into a 250-ml. volumetric flask, made up to volume with distilled water, and immediately analyzed for catalase activity. Aliquots (25 ml.) were transferred into 50-ml.

---

[1] Central Experiment Station Contribution No. 1802. Prepared in the Department of Agricultural Chemistry.

[2] The writers thank Dr. Julian Banzon, assistant head of the Department of Agricultural Chemistry, and Dr. G. O. Ocfemia, head of the Department of Plant Pathology, for advice and suggestions during the experiments.

[3] K. Yamafuji and T. Fujuki, *Biochem. Z.*, 318, 101 (1947); *Chem. Abstracts*, 42, 3030g (1948).

[4] F. Yoshihara, *Jour. Agric. Chem. Soc. Japan*, 23, 252 (1950); *Chem. Abstracts*, 44, 839g (1950).

[5] K. Yamafuji and T. Cho, *Jour. Agric. Chem. Soc. Japan*, 20, 411 (1947); *Chem. Abstracts*, 42, 5068i (1948).

flasks and mixed with 5 ml. dextrose phosphate buffer with a pH of 6.8. To each flask was added 5 ml. of the freshly prepared H_2O_2 (1:4 by volume of the 10-volume solution), and the contents were stirred and made up to volume with distilled water. After 5 minutes, 5-ml. aliquots were pipetted into 10 ml. of 2 N H_2SO_4 containing molybdate. About 0.01N of $Na_2S_2O_3$ solution in 10 per cent potassium iodide was added and back-titrated with iodine using starch as indicator. Blanks, or samples without hydrogen peroxide, were run alongside.

Abacá seedlings were supplied by the Department of Plant Pathology. Two determinations were made for each leaf sample, and the trials were run at the same time using freshly prepared peroxide to minimize errors due to the variations in temperature and the decomposition of hydrogen peroxide.

DISCUSSION OF RESULTS

The differences in the various trials may be attributed to the differences in temperature of the reaction flasks and, to some extent, to the age of the leaves. The stage of infection may also affect determination of catalase activity in the diseased plants, if virus infection does affect the action of catalase.

The results seem to suggest that catalase activity is affected by abacá mosaic virus and also by bunchy-top of abacá virus, but not as conclusively (fig. 1). Although "Katalase Fahigkeit" was not determined, the comparative amount of H_2O_2 decomposed in a definite time by the amount of sample may be used as a measure of catalase activity. On this basis, plants affected with mosaic had lower activity than healthy plants, but results with leaves infected with bunchy-top were so varied that the writers could not draw definite conclusions. The data obtained with abacá mosaic corroborate Yamafuji's postulate that catalase activity is related to virus infection.

It is possible that during the later part of the reaction the amount of H_2O_2 in the reaction flask of the healthy plants was already limiting, as shown by the high percentage of decomposed H_2O_2. This, however, does not affect the conclusions made but rather points out the fact that with the amount of sample used the enzyme was quite active. Corrections for this source of experimental error could be made by reducing the amount of sample used, shortening the reaction time, or increasing the concentration of H_2O_2.

RECOMMENDATION

If catalase activity is really related to virus infection, then the catalase activity of plants in various stages of mosaic infection should be investigated. Perhaps it may serve as a diagnostic test for mosaic infection, or perhaps the propagation of the virus may be inhibited by enhancing catalase activity, as the Japanese workers reported. In addition, the detection of catalase inhibitors in the diseased plants should be studied.

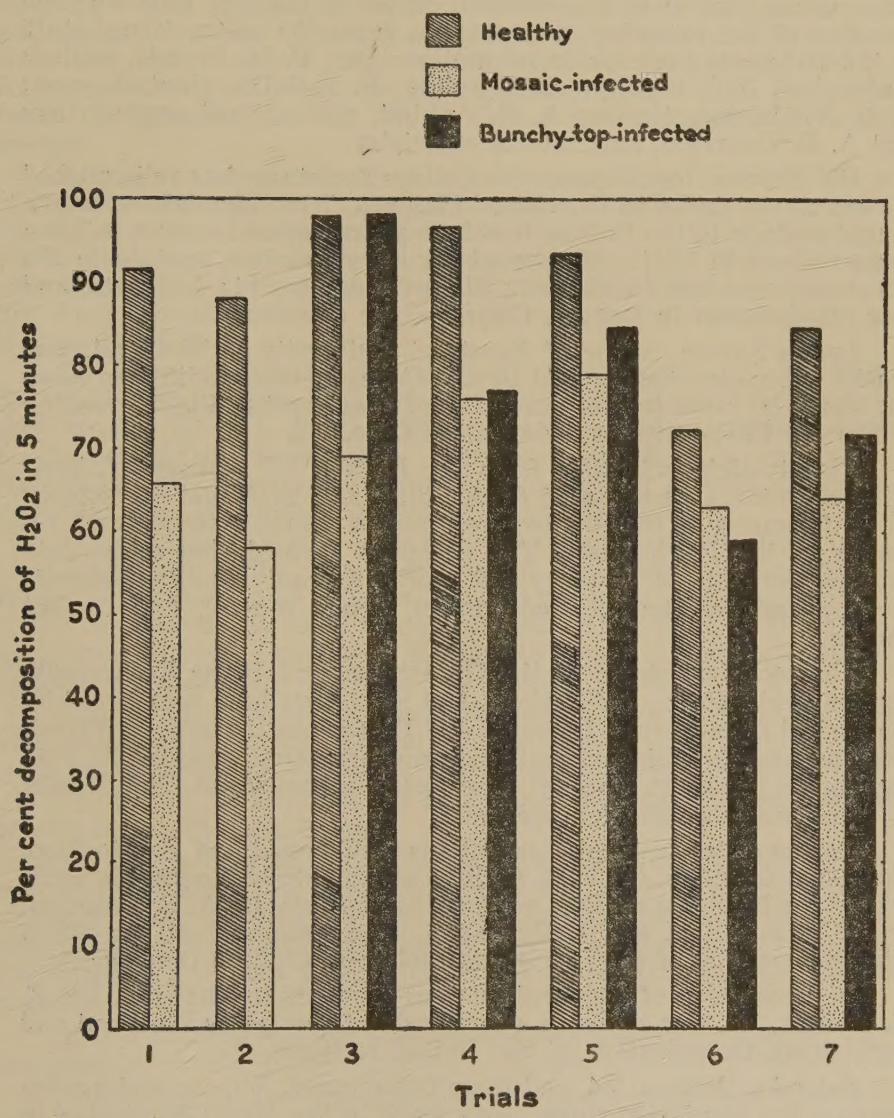

Fig. 1.–The decomposition of H_2O_2 by the leaves of healthy and diseased abacá seedlings.

COLLEGE AND ALUMNI NOTES

The first definite step towards the development of the Central Experiment Station as the research center of the Far East was the transfer of the following six scientists from the instructional staff of the College to the experiment station: Drs. F. M. Fronda, poultry husbandry; D. L. Umali, plant breeding; F. T. Orillo, plant diseases; G. B. Viado, insecticides; A. P. Aglibut, agricultural engineering; and A. R. Carangal, agricultural chemistry.

Dr. Fronda, for 27 years the College secretary, has relinquished his secretarial duties to Dr. Miguel Manresa, '37. The new secretary taught zoology in the College for three years before he went to Iowa State College in 1941. He served for six years as a captain in the US Army, returned to the Iowa State College for his doctorate, and was researchman in Denver, Colorado, for two years.

Luang Suwan, rector of Kasetsart University in Thailand, was speaker at a convocation held by the College SBO. With him were Dr. Harry H. Love, former head of the Department of Plant Breeding of Cornell University, and Magdaleno Cero, '32.

Twenty-eight scientists from the DANR, UP College of Agriculture, Araneta Institute of Agriculture, and FOA met on October 25 to formulate a coordinated program of abacá improvement research in the Philippines. The delegates formed themselves into working committees to carry out work in plant breeding, chemotherapy and fertilizers, weed control, insect control, and project finance.

The technical staffs of the Departments of Home Technology, Agricultural Botany, Entomology, and Soils have been reenforced by the arrival from Cornell University of Professors Dorothy M. Proud, dietitian and specialist in institution management, Stanford N. Fertig, herbicide expert, John G. Matthysse, entomologist, and Marlin G. Cline, soil classification specialist.

Papers on sociological observations of Vermont and Puerto Rico, illustrated by slides, by V. G. Cedillo, and on chromatographic analysis of the pigments of *Bixa orellana* Linn. seeds, by A. R. Carangal Jr., E. Manzanilla, and I. Guevarra, were presented at the 228th scientific meeting of the Los Baños Biological Club on October 29.

In recognition of technical services rendered in Thailand, Dr. F. M. Fronda, '19, was awarded a certificate of service by the Food and Agriculture Organization of the United Nations.

Salvador Beltran, '54, and Isaac Cagampang, '55, are undergoing training for plantation supervisory work in the Menzi plantation in Mati, Davao.

Lino Nazareno of Animal Husbandry and Nieves Buhay of Soils stole a march on their friends when they got married on October 27.

Another October wedding was that of Manuel T. Perigua of Agronomy and the former Remedios A. Luague of Dumaguete City.

Elected in the Student Body Organization elections held November 12 were Dalmacio Cruz, president; Felix Valera, vice-president; Felicitas Palis, secretary; Felicitas Bautista, treasurer; Lazaro Dimaculangan, Pascual Tantengco, Teodoro Ela, Godofredo Eala, Rodolfo Cid, Pete Kokunta, representatives to the Student Council in Diliman. Antonio Mabesa was elected representative to the Collegian board of management. Dr. W. C. Calma was unanimously chosen adviser.

Burmese educational officials, accompanied by Richard Morse of the Ford Foundation in Rangoon, visited the College on October 12. The visitors were Prof. U Ba of the University of Rangoon; Chelk Ping Lee, director of technical education; U Thein Maung, principal of the Agricultural Institute; and Chit Ko Ko, lecturer of the Agricultural Institute. Also with the group was Robert A. Manire of FOA.

US Army officers Lt. Col. Jodie G. Stewart Jr., Lt. Col. Paul M. Woods, Major John J. Gillespie, and Major Merle E. Hammer, accompanied by C. L. Orrben, FOA soils management advisor, were on the campus on November 6. The four officers, on a cooperative traineeship with Stanford University, are making a study of social, economic, and agricultural problems of the Far East.

Visitors from Taiwan on October 14 were Chang Yu Chen, technical supervisor of the farm management department, Taiwan Pineapple Corporation, and Chi-Lin Luh, of the plant industry division of the commission on rural reconstruction. They were accompanied by former Director Gonzalo F. Merino, Dr. Juan P. Torres, Epitacio Lanuza, and Edilberto Uichanco, all College alumni.

Speaker at a convocation held December 1 was Eugene E. Barnett, emeritus secretary general of the YMCA. He and his wife were accompanied by Alvaro L. Martinez of the Manila YMCA.

The Nyle C. Bradys left the College on December 9 after a series of despedidas in their honor.

Mr. Lauro Ynalvez of the Department of Agricultural Chemistry left on December 5 for Japan where he will study the higher techniques of glass-blowing for use in the construction and repair of glass scientific apparatus and care of electronic equipment. He will stay abroad for three months under an FOA-PHILCUSA training grant.

Dean Uichanco was the main speaker at a conference on biology and chemistry held at the Institute of Hygiene on November 23.

Diversification for higher economy was the subject of a lecture given at the Department of Agricultural Economics by Dr. John H. Black, economist and head of the graduate school of Harvard University. Dr. Black is making an economic study of the Far East.

A party of Washington statesmen, US Embassy personnel, and FOA officials visited the College on November 20 to observe the

progress of the development of the College and the Central Experiment Station. The visitors were shown around by Director Uichanco and Assistant Director Santos. The delegation was composed of Congressmen John M. Vorys and James P. Richards; Boyd Crawford, staff administrator and chief clerk of the House Committee on Foreign Affairs; Clinton Morrison, deputy regional director for the Far East of FOA in Washington; Col. Harry H. Crity and Lt. Col. James F. Hollingsworth, Department of Defense; Philander P. Claxton Jr., and A. Guy, Department of State; Charles R. Burrows, Carl H. Bochinger, A. Sabin Chase, F. Ely, and Stephen C. Brown, American Embassy; Harry Brenn, Leland Call, and Ray Johnson, FOA.

The University Board of Regents met at the Department of Home Technology on the morning of November 19, 1954. They were served coffee and a lechon buffet lunch.

Representatives of the UP College of Agriculture and the Bureaus of Plant Industry and Agricultural Extension met in the office of Director E. E. Cruz for final discussion and approval of memoranda of understanding for cooperative abaca research, of a project on abaca improvement, and another on weed control. The documents were signed by Dean Uichanco, Director Cruz, and Director Pineda. Project leaders from the College for the abaca improvement project are Doctors D. L. Umali and J. L. Brewbaker. Dr. S. N. Fertig is project leader for the weed control project.

Martin S. Celino, '29, chief of the Biology Section of the Bureau of Soil Conservation, was appointed Research Associate Professor of Plant Pathology in the College of Agriculture and Central Experiment Station on November 16, 1954. Professor Celino is working on the mosaic of abacá and cadang-cadang of coconut.

Professor A. B. Catambay, head of the Department of Agricultural Engineering, was appointed farm superintendent in order to coordinate planting and insure the proper use of farm land.

Dr. Getulio B. Viado headed a group that went on a recent four-day trip to Mindanao to observe the extent of the abacá mosaic disease. With Victorino Madrid of the Bureau of Plant Industry and Dr. J. G. Matthysse of the Department of Entomology, he visited Bago Oshiro. The three men are members of a five-man committee which plans to lay out a research project to be undertaken cooperatively by the college and the bureau. One of the project points is the study of disease transmission by insect vectors.

Dr. G. O. Ocfemia, who has been awarded a John Simon Guggenheim Memorial Foundation fellowship, will pursue further work on insect transmission of plant virus disease with Dr. Francis O. Holmes as a visiting investigator in the Rockefeller Institute for Medical Research in New York City beginning May 1, 1955.

A general view of the main problems of agricultural science in the country was presented to the student body of the College in a scientific program held on November 22, 1954. Dean L. B. Uichanco spoke on the importance of developing an interest in the sciences. Ten papers covering different phases of agriculture were read.